Property Rights, Risk and Development: Community-Level Range Management in Niger

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A dissertation submitted to the Faculty of Graduate Studies in partial fulfilment of the requirements for the degree of Doctor of Philosophy

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Abstract

This dissertation contributes to the debate on Common Pool Natural Resources (CPNRs) through the analysis of a specific case study: rangeland in southwest agro-pastoral Niger. The management of CPNRs is the subject of a lively debate pertaining to the property rights regime that may accompany CPNR management. This dissertation shows that this debate may very well be the consequence of disciplinary preconceptions that are linked with disciplinary paradigms. By approaching the case study with an interdisciplinary approach, this dissertation shows how interdisciplinary research may contribute to the avoidance of "universalism" (i.e., one property rights regime fits all CPNRs) with regard to CPNR management.

The case study is approached by using three different conceptual frameworks in order to explore five research questions. A first framework, econometric modelling, is used to explore the following two questions: "what are the determinants of rangeland use in southwest agro-pastoral Niger?" and "what are the determinants of livestock mobility?" A second framework, event chronology analysis, is used to explore the following two questions: "what is the impact of rainfall shocks on rangeland property rights?" and "is the marginalization of the pastoral space avoidable and reversible?" A third framework, network analysis, allows for the exploration of: "do traditional local institutions have the

capacity to play a role in the management of rangeland?" The analysis and discussion of these research questions point to the fact that community-level rangeland management in southwest agro-pastoral Niger is a definite possibility. Nevertheless, it will be possible only if livestock raising practices are strong in the two traditional producer groups: agriculturalists and pastoralists. Community-level management will, therefore, have to be rooted in the community that is constituted by the users of the rangeland.

Finally this dissertation concludes by stressing the results in terms of rangeland-management policy for Niger, in terms of the interdisciplinary analysis of CPNR, and in terms of conducting interdisciplinary research in general.

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CHAPTER I: INTRODUCTION

I.1 Objective of the research

Common pool natural resources (CPNRs) are resources in which (a) exclusion is non-trivial (but not necessarily impossible) and (b) yield is subtractable (Ostrom et al. 1992). The analysis of CPNRs is the subject of a fairly active debate on whether CPNRs should be privatized, whether management of these resources should lie at the individual, community or state level. This debate is in part sustained by paradigmatic differences between the disciplines analysing CPNRs.

The purpose of this dissertation is to contribute to the debate on the potential role of local communities in the management of common pool natural resources (CPNR). This contribution is achieved through an interdisciplinary analysis of a particular case study: rangeland management in southwest agro-pastoral[1] Niger.

The conceptualization of CPNR management has been approached through several disciplinary fields (e.g., economics, political economy, sociology, ecology, geography),

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[1]Throughout the text the adjective agro-pastoral will be used to refer to the joint practice of crop agriculture and livestock raising.

some of which led to relatively broad and universal conclusions on CPNR management and its implementation. The goal of this research is to illustrate that there cannot be a single universal approach to the analysis of CPNRs and their management, i.e., that, when analysing CPNRs, there is a need to constantly negotiate disciplinary boundaries (Massey 1999), there is a need to link social and ecological systems (Berkes and Folke 1998).

Rangeland in southwest agro-pastoral Niger has been chosen as a case study because of some of its key characteristics. First, rangeland in southwest agro-pastoral Niger is a CPNR. Access to rangeland has not been traditionally controlled and rangeland's forage is substractable (i.e., when forage is collected or grazed by livestock it cannot be collected or grazed "a second time"). Second, there are some very strong justifications for rangeland being a CPNR in Niger. For example, a major justification lies in the need for livestock to be mobile as a risk management strategy against erratic rainfall. Finally, rangeland tenure in southwest agro-pastoral Niger is under stress because of key changes in the natural (increase in the number of drought years) and socio-political (population pressure, political instability) environments . The understanding of community-level rangeland management in Niger calls, therefore, for an understanding of the natural environment, the socio-institutional environment, and the economic environment – and their interactions.

I.2 Overview of the research

This overview will begin with a brief description of the avenues that have been proposed for the management of CPNR in terms of property rights. Following this analysis, the potential linkages between property rights structure and production risk will be briefly covered. The relevance of the study of livestock development in Niger in terms of the analysis of CPNR and the linkages between property rights structure and production risk will then be presented, followed by the context of the case study and a description of the hypotheses that are tested in the course of this research. The next section describes the different analytical frameworks that were chosen as well as the methods that were used. Finally, the structure of this dissertation is presented.

Managing CPNRs

In this research, the concept of management is used as the "regulation of internal use patterns or the transformation of the resource by making improvement" (Schlager and Ostrom 1992). While the management of natural resources can serve several purposes (e.g., economic efficiency, equity, sustainability), it is not necessarily the goal here to identify management objectives. The purpose here is to analyse the role that local

communities[1] may have in the regulation of the usage of the resources that they are using. It is, therefore, not the purpose here to evaluate whether a certain management objective is met. The purpose is, rather, to assess whether local communities may have a role in managing the resources that they use.

Property rights and CPNRs

The purpose of this section is to briefly present the linkages between property rights theory and the common property debate. These linkages are presented in details in Chapter II where the different sources supporting the argumentation are presented. Property rights can be divided into five sets of rights (Schlager and Ostrom 1992): access, withdrawal, management, exclusion, and alienation. Access right is the right to physically enter a geographical unit, it does not necessarily include the right to withdraw the resource that is present on the geographical unit for which access right is granted. Withdrawal right is the right to withdraw the resource. Exclusion right is the right to exclude an agent from the resource (e.g., by enclosing the resource, by devising a licensing scheme). Management right is the right to regulate internal use patterns and transform the resource by making improvements. Alienation right is the right to sell or

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[1]Community is defined as "a social group of any size whose members reside in a specific locality, share government, and have a common cultural and historical heritage" (The Random House Dictionary of the English Language, 1979).

give away one or several of the aforementioned four rights. CPNRs are by definition resources where the control of access and withdrawal rights (i.e., the expression of exclusion rights) is not easy to implement. The regulation of internal use patterns (i.e., management) has to be exercised through exclusion (i.e., the control of access and withdrawal rights). The exercise of exclusion rights necessitates collective action.

The failure, in terms of economic efficiency or in terms of sustainability, of some CPNRs where access and withdrawal rights to the resource were granted to everyone led to a wide body of theoretical literature arguing that CPNRs can only be managed through the control of a central authority (i.e., the state) or through privatization of the resource (e.g., Clark 1977, Coase 1960, Gordon 1954, Hardin 1968, McHugh 1972, Scott 1955). Nevertheless, this approach to CPNR management failed to take into account the empirical evidence that CPNRs could be successfully managed locally without control by a central authority or without privatization of the resource (e.g., Forman 1967, Ostrom 1990).

The recognition of the importance of locally-managed CPNRs led to a second body of literature arguing that the management of CPNRs should be entrusted to local communities, this being particularly true when the "common" nature of a CPNR seems to serve a purpose (e.g., greater equity, risk management strategy). Nevertheless, in order to successfully manage local CPNRs, local communities must have the following

elements: the right to exclude outsiders from the resource, a control of the determinants of their CPNR use, access to information that may be needed in order to take managerial decisions, and the capacity to enter into collective action towards the goal of CPNR management. This is not always the case. There are many instances where these conditions are not met (e.g., fisheries, watersheds).

The recognition of the potential difficulties for many communities to manage CPNRs "on their own" led to a third body of literature which recommends multi-stakeholder management structures, also called co-management structures (Berkes 1994, 1997, Berkes and Feeny 1990, Pinkerton 1992, 1993, Pomeroy and Pido 1995, Witty 1994).

When approaching CPNR management there are, therefore, at least four possible "avenues": control by a central authority, privatization, community-level management, and shared management or co-management (cf. Baland and Platteau 1996). None of these avenues should be seen as a "panacea" and it is extremely important when approaching a particular CPNR to remain open-minded as to the management options that are available. Before addressing the issue of the potential role of local communities in the management of a particular CPNR, it is important to answer some key questions in terms of property rights.

First – and while this may seem fundamental, it is rarely addressed – the question of

whether the resource is actually managed has to be answered (i.e., are internal use patterns regulated or are there improvements made by transforming the ressource). A second issue lies in the identification of the role that the "common" nature of the CPNR under scrutiny may serve (i.e., does the property rights structure, where access right is given to a group, serve a purpose?). Once these questions have been answered, other questions need to be addressed; namely, how is, or could, a community's control over its CPNR taking place (i.e, what are the pathways to implement a control of access and withdrawal rights), and through which institution could this control be exercised?

Second, the issue of the purpose served by the property rights structure is particularly important. If the property rights structure that is observed serves a purpose, this limits some of the management options that could be envisioned. This has led several authors (e.g., Canterbery and Marvasti 1992) to consider that the "tragedy of the commons" lies in their privatization, rather than in their "common" nature. When considering natural resources that are directly, and more or less regularly, impacted by changes in their natural environment, these variations represent a production risk for the communities exploiting these resources. It has been argued that the pooling of these resources can reduce the consequences of variations in the natural environment. This argument has been developed theoretically by van den Brink et al. (1995) who demonstrates theoretically that the existence of CPNRs in a variable environment may be a rational adaptation that allows a reduction of the impact of rainfall variability on production.

Numerous field evidences are found in Niamir-Fuller (1998). In terms of this research, for instance, this demonstration is achieved in order to explain the simultaneous existence of private (cultivated land) and common (rangeland) natural resources in an area such as southwest Niger.

None of the questions identified above can be answered without a careful analysis of the linkages between the natural environment, the economic environment, and the social environment of the community involved in the use of the CPNR. Nevertheless, decisions regarding the choice of a management option have often been taken without proper consideration of these issues. The case study presented in this dissertation allows an exploration of different approaches that can be used to answer these questions. It gives an opportunity to illustrate the complexity of the issues linked with CPNR management and its analysis. Furthermore, the case study shows that this complexity can only be approached by integrating different disciplinary fields. Interdisciplinary enquiry is not generally supported by disciplinary PhD programs. On the contrary, the program that allowed for this dissertation research to be undertaken (i.e., the Environmental Studies program at York University) gives the intellectual space for such an enquiry. The section that follows shows how the interdisciplinary case study can be particularly enlightening.

Niger case study

Livestock production in Niger has up to now been dependant on rangeland use. Rangeland productivity is intimately linked with rainfall quantity. Rangeland is most often an open access or limited access CPNR. Furthermore, rainfall variation in Niger is important (see Section 1.3). The case study can, therefore, exemplify a situation where the existence of a CPNR can be justified in the framework developed by van den Brink et al. (1995).

While this case study contributes to a better understanding of how CPNR management can be approached, the case study in itself is quite important. In Niger, the government has been trying to redefine property relations through the definition and the implementation of a new *Code Rural* (rural code). This new *Code Rural* is an intitiative to draft a land tenure legislation that is putting an emphasis on community level control of natural resources. This implementation calls for a clear understanding of the relationship between rainfall variability, resource use, and the current land tenure system. This dissertation analyses these interactions for the southwest agro-pastoral Niger pastoral action space (i.e., the physical space where pastoral activities are undertaken) which consists of open access and limited access common pool rangeland. While the *Code Rural* does put an emphasis on local-level natural resource management (thus choosing a management option), very little is said about the management of rangeland.

This must be considered as a major oversight because rangeland constitutes more than 80% of the total agricultural area in Niger. In southwest agro-pastoral Niger, the proportion of rangeland in villages surveyed in the course of the present research ranged between 0% and 78% (with an average 44%). By focussing specifically on rangeland management, this dissertation could contribute to a better understanding of the possible pathways for community-level rangeland management and, therefore, for livestock development in southwest agro-pastoral Niger.

I.3 The context of the research

A former French colony, Niger gained its independence in 1960. Between 1960-1974, Hamani Diori remained in power as president, winning three electoral mandates. In 1974, Seiny Kountché led a coup d'état and controlled Niger up to 1987 when, following his death, he was succeeded by Ali Saïbou. Civilian rule was returned through elections in 1990. Since 1990, Niger has gone through two more coups d'état. The first, in 1996, ousted Mahame Ousmane. The second ousted Ibrahim Mainassara Baré in 1999. Currently, Niger has an elected president at its head, Mamadou Tandja.

Located in West Africa, Niger is a land-locked country sharing borders (going clockwise) with Algeria and Lybia to the north, Tchad to the east, Nigeria and Benin to the south and

Mali and Burkina-Faso to the west. (See Figure I.1[1].) Of its 1.27M km^2, only 10% consists of agricultural land (i.e., land used for agriculture and/or livestock raising) of which less then 20% is actually considered as being able to sustain agriculture (FAO 1998). Most of Niger receives less than 1000 mm rainfall annually, while more than 75% receives less than 300 mm. Rainfall is concentrated during a single rainy season (May to October). Inter-seasonal, intra-seasonal, and spatial rainfall variability is important and constitutes the most important environmental risk for agriculture and livestock raising in Niger. A general decrease of average annual rainfall has been observed since the early 1970s. When comparing average annual rainfall between 1930 and 1960 and average annual rainfall between 1973 and 1995, this decrease amounts to more than 15% .

The population of Niger is divided economically into two major groups: traditionally sedentary agriculturalists and traditionally mobile pastoralists. It is important to note that this distinction is based on the historic tradition of these groups. Presently, both groups generally practice both pastoral and agricultural activities. Among traditional agriculturalists, it is possible to identify three geographic units with their respective populations. Western Niger, up to four degrees East, consists mainly of Zarma, Songhai,

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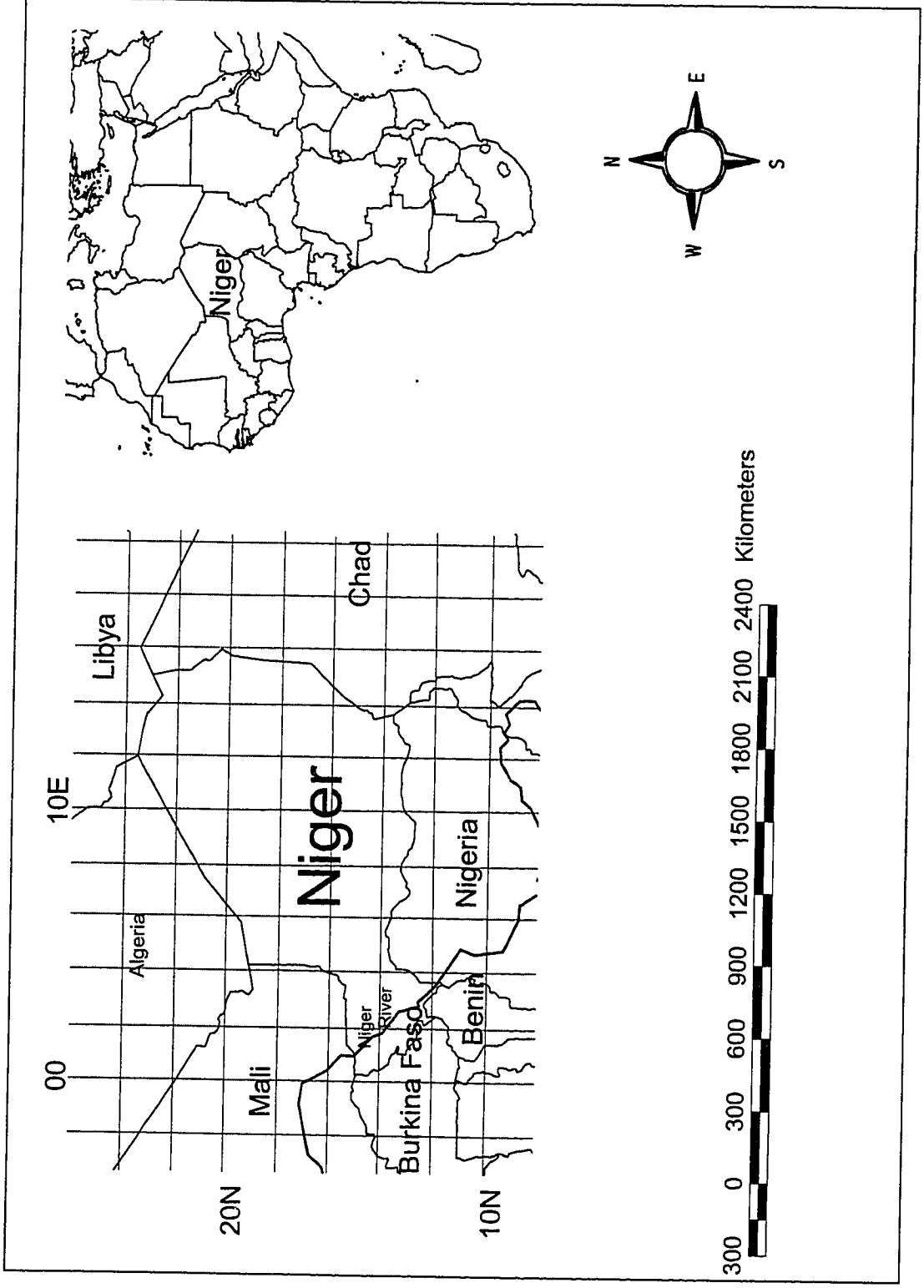
[1]All the maps that are presented were made by the author using Arcview 3.2. International borders come from the base map found in ESRI 1998. All other features were digitized by the author using either Atlas-GIS 2.0 for DOS first then Arcview 3.2 or using Arcview 3.2 only.

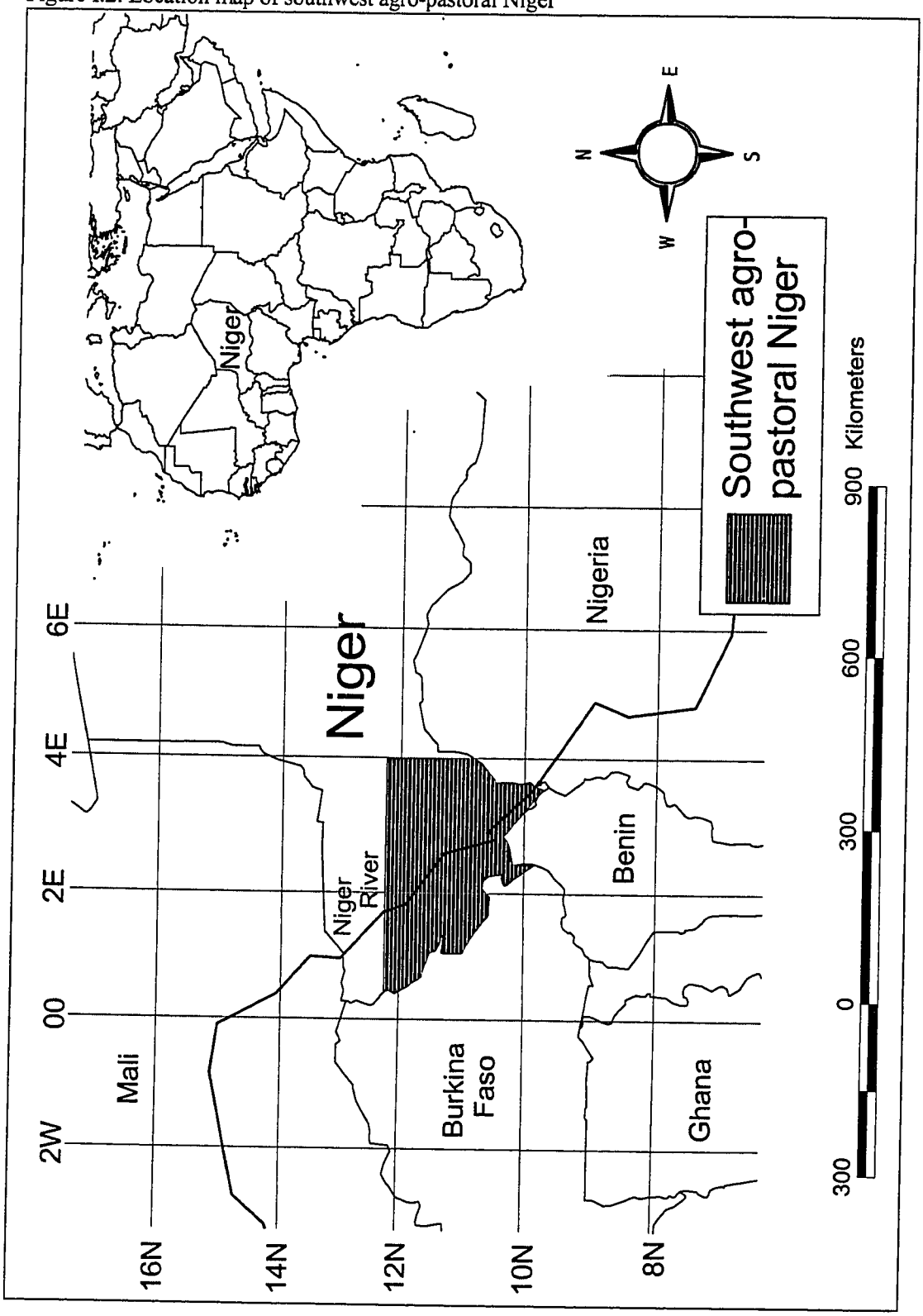
Figure I.1: Location map of Niger



and Gourmantché. Central Niger is home to the Haussa (the most important group in terms of numbers), while eastern Niger is home to the Kanuri. Among traditional pastoralists, there are four groups: Twaregs and their former servants and slaves (Bella), Fulanis, Toubou, and Arabs. Following the droughts in 1973-74 and 1983-84, most traditional pastoralists became more sedentary and, in order to survive the loss of their livestock, they began the practice of crop agriculture (Bonfiglioli 1990, Salifou 1989). Niger can be divided into two distinct areas. The first is south of the 300mm isohyet (i.e., line joining the locations where the mean annual rainfall equals 300mm) -- the "official" limit of millet cultivation -- where crop agriculture dominates, but where livestock raising is widely practised; named the *zone agro-pastorale*, it is the area where interactions between crops and livestock occur and where competition for land between these two production systems is important. It must be noted that in Niger there is noflood recession agriculture. Therefore, the situation in Niger is different from the situation in Mali as it is described by Moorehead (1989). The other area, north of the 300mm isohyet, named the *zone pastorale*, is an area where livestock raising dominates. Nevertheless, this area, because of water scarcity, is mostly used as pasture on a seasonal basis.

This research was conducted in southwest agro-pastoral Niger, a region that can be delimited by the 300 mm isohyet to the north, Burkina Faso to the west, Benin and Nigeria to south and southeast, and four degrees East, the limit roughly separating the

Figure I.2: Location map of southwest agro-pastoral Niger



Zarma part of the territory from the Haoussa part, to the east. (See Figure I.2.)

Several key characteristics of southwest agro-pastoral Niger are essential to understanding the context of the case study (i.e., rangeland management in southwest agro-pastoral Niger): rainfall variability, property rights, livestock mobility, and livestock development. These will be discussed in greater detail in later chapters, but will be introduced here.

Rainfall variability

Southwest agro-pastoral Niger can be characterized by the relatively low and variable rainfall as well as by a recent history of droughts. While the end of the rainy season occurs at a relatively fixed date, the rainy season onset date and the total rainfall show important temporal and spatial variability. This variability has a direct impact on agricultural, pastoral, and agro-pastoral production systems. Because of the importance of this production risk, it must be taken into account when analysing production systems. Nevertheless, this poses a particular challenge. Rainfall variability can be understood in terms of the variance (statistical variance) of rainfall and the impact that this variance has on producers. Rainfall variability can also be understood in terms of the occurrence of random shocks (i.e., drought years) and the impact that these shocks may have. In the remainder of the text, "rainfall variability" will refer to the (inter-annual statistical)

variance of total annual rainfall. "Rainfall shock" will refer to serious rainfall deficit (drought). "Rainfall risk" or "risk" will refer to both.

Property rights

While the literature on land tenure in Africa is rich and diverse (e.g., Agbosu 1988, Atwood 1990, Basset 1993a, 1993b, Berry 1988, Besteman 1994, 1992, Bruce 1988, 1993, Bruce and Migot-Adholla 1994, Cheater 1990, Cissé 1982, Goheen 1992, Kintz 1982, Lund 1996, Migot-Adholla et al. 1991, Moorehead and Lane 1995, Morton 1996, Peters 1992, Place and Hazel 1992, Platteau 1995, 1996, Saul 1988, 1993, Shipton and Goheen 1992, Sjaastad and Bromley 1997), the focus of this section and of Chapter III will be on the literature that is specifically available for Niger. Property rights as they relate to land in Niger consist of a mix of private property (i.e., cultivated land during the rainy season), property where access is granted to a specific group or to any user (i.e., rangeland during the rainy season), and property where access is granted to anyone (i.e., agricultural land and rangeland during the dry season) (Ngaido 1993a, b, Williams 1997).

Another important characteristic of southwest agro-pastoral Niger is the changing institutional environment. Since Niger's independence, several land tenure reforms – all of them only partially implemented – were enacted. This has created uncertainty in terms of tenure status at the village level. Competing claims regarding land use and ownership

are often expressed and are settled on an ad hoc basis by local or regional authorities. It must be stressed, however, that local authorities in southwest agro-pastoral Niger often belong to ethnic groups with a strong agricultural tradition. Therefore, there may be a tendency for these authorities to settle land-use conflicts between agriculturalists and transhumant herders in favour of the former.

Livestock mobility

Another central feature of the Nigerien context is livestock mobility. At the onset of the rainy season, livestock are sent into transhumance (i.e., long-term seasonal migration to a better pastoral space) to pastures in northern Niger, outside of the agro-pastoral area (i.e., north of the 300 mm isohyet). While livestock mobility is now widely understood as a rational *ex post* adaptation to local insufficient rainfall (Behnke and Kerven 1994, Behnke and Scoones 1993, Niamir-Fuller 1998, Niamir-Fuller 1999, Turner 1999b), it must be stressed that personal observations in Niger show that the decision to send livestock into transhumance is taken early in the rainy season (i.e., before being able to assess whether rainfall will be sufficient). Nevertheless, this decision is based on long term information regarding rainfall patterns and variability, and the occurrence of drought. Furthermore, during the present research, key informants repeatedly stressed the fact that pastures in northern Niger are of particularly high quality. Livestock mobility, therefore, can be understood as: the desire to tend livestock in an area where

mobility is possible without interacting negatively with agriculture, thus making mobility a risk management strategy; and the desire to exploit quality rangeland, which would not be a risk management strategy *per se*, but rather a rent capture strategy. In order to reach the northern pastures, livestock mobility must remain possible. Therefore, some of the rangeland on the way to the North must remain accessible. This in turn may have a consequence on rangeland tenure, namely that access rights and withdrawal rights must be granted to transhumant herds. This linkage between rainfall variability, livestock mobility, and rangeland tenure lies at the core of the present research.

Livestock production

Livestock raising is mostly practised by the rural population. While urban dwellers do own livestock, they will either entrust their livestock to rural dwellers or raise their livestock with limited mobility in the urban and peri-urban area. In the rural areas, two livestock production systems co-exist. First, pastoralists concentrate their economic activity on livestock raising. They belong to ethnic groups with a strong pastoral tradition of mobility (i.e, Fulani, Bellas). Second, agro-pastoralists practice agriculture and livestock raising jointly and most belong to ethnic groups with a strong agricultural tradition (i.e., Zarma, Haussa). Both agro-pastoralists and pastoralists practice mostly extensive livestock raising (i.e., livestock is raised using relatively big areas as opposed to small areas or fenced fields).

Livestock raising faces many challenges in Niger, two of which will be touched on here. First, there is a general agreement among pastoral groups, researchers, and development professionals that the pastoral action space in southwest agro-pastoral Niger is being progressively and irreversibly marginalised (i.e., rangeland increasingly consists of marginal land, unsuitable for agriculture, of poor quality even for livestock raising purposes). This can be seen as a consequence of increases in the area under cultivation. Between 1968 and 1980, cultivated land increased in area by 50% (Pons 1988). While very little recent data exist, evidence of this marginalisation is found in different case studies (e.g., Colin de Verdière 1995). The consequence in southwest agro-pastoral Niger is that the pastoral action space is increasingly closed (i.e., the pastoral space consists of disconnected or poorly connected low-quality pastures). This, of course, reduces dramatically the opportunities for livestock mobility during the rainy season, perhaps even at its onset.

A second challenge facing livestock raising is a transfer of livestock ownership from traditional pastoralists to traditional agriculturalists and urban dwellers. It is generally considered that 25-60% of herds currently belong to absentee owners (Pons 1988). This could potentially lead to a knowledge gap, with traditional pastoralists losing the incentive or the possibility to use or transfer their traditional ecological knowledge for livestock raising purposes.

I.4 Research questions

The general scientific context of the research presented in Section I.1 and Niger's particular context presented in Section I.2 led to the identification and the formulation of five key research questions. The following section gives the formulation of these questions as well as the rationale behind their formulation.

What are the determinants of rangeland use in southwest agro-pastoral Niger?

When addressing the question of community-level CPNR management, it is extremely important to first identify the determinants of internal use patterns in order to assess whether these are regulated. In the case of southwest agro-pastoral Niger, the focus will be on rangeland use during the rainy season (i.e., intra-seasonal management). While inter-seasonal issues (i.e., range degradation over two or more seasons) are important, these will not be addressed here due to time and data availability constraints.

What are the determinants of livestock mobility in southwest agro-pastoral Niger?

As noted above, the fact that rangeland is a CPNR where access and withdrawal rights are granted to outsiders may be seen as a rational adaptation to rainfall variability (as

noted above, "rainfall variability" is used here as an equivalent of the inter-annual [statistical] variance of annual rainfall). This is directly linked with the fact that the pooling of range resources allows for livestock mobility to occur. Nevertheless, the situation in southwest agro-pastoral Niger regarding livestock mobility is quite unique because the decision to be mobile (i.e., moving livestock to open pastoral spaces in the North) is taken early in the rainy season. It is, therefore, important to identify the determinants of this *ex ante* decision of sending livestock into transhumance, and to assess whether risk is part of these determinants. This should allow a clearer understanding as to whether the social articulation of rainfall variability is linked with livestock mobility and, therefore, with a property rights structure which allows for this mobility.

What is the impact of rainfall shocks on rangeland property rights?

The purpose here is to explore whether drought years (rainfall shocks) have a lasting impact on land tenure and/or management decisions. This issue is particularly important because Niger's rainfall risk manifests itself not only through rainfall variance, but also through the occurrence of serious rainfall shocks (drought).

Is the marginalization of the pastoral space avoidable or reversible?

The dominant conclusion of the literature on the closure and marginalization of pastoral space is that it seems that they are not reversible. This has important implications in terms of land tenure and land use policy. First, it could mean that any policy geared to re-opening the pastoral action space may be extremely difficult to implement. Second, it could mean that extensive pastoral production systems in Niger may progressively disappear.

Do traditional local institutions have the capacity to play a role in the management of rangeland

Finally, when considering the role of communities in range management, traditional institutions (e.g., village chiefs, family relations) may or may not be capable of taking care of the management process. As noted earlier, Niger's institutional environment is quite uncertain, and one could safely assume that local traditional institutions are slowly giving way to non-local institutions (e.g., the market, the state). One must note, however, that this issue in Niger is complicated by the fact that rangeland on the village land (depending on the local property rights structure governing access to the resource) may be used by members of the community as well as by outsiders. This means that management entails collective action at the village level, as well as collective action

between different user groups (i.e., agro-pastoralists and transhumant herders).

I.5 Analytical frameworks

In order to answer these research questions, several analytical frameworks were chosen. The rationale behind these choices lies at three levels. First, the research was part of a larger project[1] involving inter-country comparison, resulting in a necessity to standardize the approaches that were used. Second, the nature of each research question called for specific approaches. For instance, the question on rangeland use determinants under rainfall variability called for a framework that would combine both issues. Management entailing collective action, a game theoretic framework (particularly following McCarthy 1998, 2001 and McCarthy et al. 1998, forthcoming) seemed to lend itself elegantly to the questions at hand. Third, the nature of some of the questions created constraints in

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[1]This dissertation research was conducted as part of the joint Göttingen Research Institute for Rural Development, Georg-August University, International Livestock Research Institute and International Food Policy Research Institute "Property Rights, Risk, and Livestock Development" project. This project was principally funded by the German Federal Ministry for Economic Cooperation and Development (BMZ). The author was, therefore, part of a larger research team. When considering the present dissertation the author has undertaken the following tasks jointly with the other team members: design of the socio-economic survey tools, design of the rangeland quality survey tools, pre-testing of both survey tools, development of the structural model for Chapter IV, econometric analysis of Chapter IV. All other theoretical developments, survey design and implementation, and data analysis and discussion were undertaken by the author alone under the guidance of his supervisory committee and with the support during fieldwork of two interviewers/translators and two professional drivers.

terms of data availability. For instance, the hypothesis on the linkage between rainfall shocks and rangeland tenure called for an historical perspective. Village-level time series information on the issues at hand being non-existent, a chronological analysis was a viable route.

It is important to stress here that the diversity of these qestions is at the core of the complexity linked with the analysis of CPNRs. CPNR analysis cannot be summarized by a single research question and, therefore, CPNR analysis calls for the integration of different analytical frameworks. This integration does not occur "naturally" in disciplinary fields of enquiry. This explains the realization of this dissertation within the interdisciplinary context of environmental studies.

Econometric modelling

The two first research questions – on range use determinants and livestock mobility – were answered using econometric modelling. By using recent results in cooperative game theory applied to rangeland management, structural equations were developed (McCarthy 1998, McCarthy et al. 1998, 2001). Reduced form equations were estimated and hypotheses were tested. One of the major features of the model developed is the fact that property rights only appear under the expression of a management right. The other important feature of this model is that rainfall risk appears as the variance of annual

rainfall.

In order to estimate the reduced form equation, data were gathered through a survey of 40 agro-pastoral communities conducted in 1997 and 1998. The survey consisted of a resource mapping and subsequent assessment, as well as the collection of socio-economic data. Each village was visited twice for two and a half days on average. Data were also collected on livestock prices and on transhumance contracts in a separate surveys.

Historical events analysis

In order to answer the research questions on the impact of drought and the reversibility of pastoral space marginalization, an historical events analysis was developed in four villages. An historical events analysis consists of the building of a local events history and the linking-up of these events with non-local events. It allows for the identification of local level historical particularities. The historical events analysis was designed in order to allow for the comparison of village-level history, climate history, and land use history. The four villages were chosen among the 40 villages surveyed because, while sharing characteristics in terms of natural environment, they showed different property rights arrangements. Two pairs consisted of a village where range enclosure was at least partially implemented and a village where range enclosure was not implemented.

Three approaches were used in order to develop local-level history. First, focus groups, stratified by age and gender, were conducted in each village. The objective of each focus group was to establish an historical baseline for the village in terms of major events, land-use patterns, rainfall shocks, and livestock and agricultural production. Second, in each village, semi-structured interviews were conducted in 20 households in order to confirm the historical account that was established during the focus groups. Furthermore, these household-level interviews were used to assess the impact of major events and rainfall shocks at the household level. Finally, the village lands were surveyed with key informants in order to assess more precisely historical land-use patterns.

Sociometric analysis

In order to answer the question regarding the ability of traditional institutions to conduct range management, a new conceptual framework was developed using results from conflict resolution theory. This conceptual framework was operationalized by applying quantitative communication network theory designed to allow a clear understanding of how different institutions shape communication among community members and between members of the community and outsiders. The institutions under scrutiny were family institutions, property rights institutions, local traditional authority institutions, manure contracts, and transhumance contracts.

In order to gather the data for this analysis, two villages were chosen. In each village, household surveys were conducted using snowball sampling. The questionnaires used for the surveys consisted of series of name generators stratified by realms of socio-economic activities. The core sample consisted of 20 randomly-chosen households, while the final sample consisted of 75 households for the larger village and 56 households for the smaller.

I.6 Structure of the dissertation

Following the present introductory chapter, Chapter II gives a summary of current and past approaches used to model CPNR management. An emphasis is placed on the application of traditional economics to natural resource management. A first section presents the modelling approach used in traditional economics, while a second section describes its limitations when trying to apply it to the analysis of community-level CPNR management. The third and fourth sections cover the results of approaches that can be identified as alternatives to the neo-classical economics paradigm.

Chapter III provides an account of the situation in terms rainfall risk, property rights and livestock development in Niger. The focus is on the linkages between these issues and community-level rangeland management.

Chapters IV, V, and VI form the core of this dissertation. Rather then separating chapters by each research question, each chapter groups research questions that are answered using the same analytical framework. Chapter IV covers the econometric analysis: the development of the structural equations, the reduced form equations, the methods used for data collection, the estimation procedure, the results, and their discussion. Chapter V covers the historical events analysis and its results, and Chapter VI the sociometric analysis and its results.

Chapter VII concludes the dissertation. A first section summarizes the results of the case study and discusses how these results can be integrated into one coherent argument for Niger. A second section covers the potential implications in terms of policies of the results; this is achieved both specifically for Niger and for CPNR management in general. A last section explores possible areas of future research in the field.

CHAPTER II: APPROACHING COMMON POOL NATURAL RESOURCES

II.1 Introduction

This chapter presents a synthesis of the current and past approaches used to conceptualize CPNR management. While economics was for a long time the dominant field in terms of CPNR analysis, recently several disciplines have been involved in CPNR analysis (cf. Baland and Platteau 1996). Because of their overwhelming influence, a short description of the fields in economics that have been applied to CPNR conceptualization and their application begins this presentation, followed by the limitations of economics when applied to CPNRs. Lastly, the results of alternatives to the models that stemmed from classical natural resource economics are presented. This leads to the conclusion that there is no one single solution to the management of CPNRs, i.e., that when approaching CPNR analysis, great care must be taken to not decide beforehand that a particular management option is the solution that fits all CPNRs.

CPNRs are natural resources in which (a) exclusion is non-trivial (but not necessarily impossible) and (b) yield is subtractable (Ostrom et al. 1992). This leads to particular characteristics in terms of property rights structure for CPNRs. Property rights consist

of a bundle of rights: access, withdrawal, exclusion, management, and alienation (Schlager and Ostrom 1992). The nature of CPNRs (i.e., exclusion is non-trivial) means that the allocation of access rights and withdrawal rights to specific individuals is difficult to implement (i.e., it is difficult, or costly, to prevent potential or actual resource users from accessing the resource and withdrawing it). As will be seen, the property rights structure (i.e., the nature of the above five rights associated with property rights) has been the focus of the different management options that were envisioned for CPNRs.

II.2 Lessons from economics

This section presents a brief description of the way that the discipline of economics models the behaviour of economic agents and the results that stem from this modelling. The objective is not to go deeply into the mathematical details of economics, but rather to identify key elements of economics that are relevant to the debate on CPNR analysis. The phrase "traditional economics" here refers to classical and neoclassical micro-economics (cf. Varian 1992).

Modelling of behaviour

In traditional economics, agents are modelled as constrained maximisers. Consumers,

for instance, are associated with a function of the goods and services that they consume. This function, called a utility function, takes values depending on the bundle of goods and services that a consumer consumes. The higher the preference of the consumers for the bundle of goods considered, the higher the values of the utility function. The utility function is not an absolute measure of welfare; it is just a tool used to order the bundles of goods. In traditional economics, the assumption is that agents will seek to maximize the value of their utility functions. In other words, they will want to get the bundle of goods that they prefer. Unfortunately for the agents, there is a limit to what they can afford: their revenue in relation with the prices of goods and services. Therefore, agents are modelled as constrained (by their revenue) maximisers (i.e., they maximize their utility). Another instance is firm theory, where firms are modelled as profit maximisers under the constraint of technology, while prices are given by the market.

To summarize, agents' behaviours are modelled using a restrictive set of information: the agents' preferences in terms of goods and services that they consume, the prices of goods and services, and their revenue (or the agents' profits that are fixed by their costs and revenue, and the available technology). Agents do not take into consideration their impact on other agents' well-being.

Defining efficiency

Because traditional economics and its results emphasize the goal of economic efficiency, it is important to define "efficiency." The concept of efficiency used in traditional economics is Paretian efficiency (or Pareto efficiency or the Pareto criterion) (Varian 1992, p. 225). An allocation of goods and resources will be Pareto-efficient if it is not possible to make one economic agent better off without making another agent worse off. According to this criterion, an efficient situation is one where it is impossible to make someone better off without harming someone. Furthermore, situations where at least one agent is better off and one agent is worse off are considered as not comparable. This criterion seems quite difficult to reject. Nevertheless, it is a normative criterion in the sense that it impedes any inter-personal comparison (e.g., if the "richest" agent "loses" a tiny fraction of well being, the situations are not comparable). Again, the emphasis is on individuals and not on groups. This efficiency criterion can be extended in an inter-temporal framework. Once inter-temporal issues are considered, account must be taken of the discount rate which is "the return on foregone present consumption that is sacrificed to secure future consumption" (Norgaard and Howarth 1991, p. 89).

Some striking results

Using this modelling of economic agents' behaviour (the micro-foundation) and

aggregating the modelled behaviour, traditional economics manages to provide some striking results. First, a competitive market with no transaction costs leads to a Pareto efficient allocation of goods and resources. This is often called the first theorem of welfare economics. Second, Paretian efficiency and distributional issues can be dealt with separately. This is the second theorem of welfare economics. These two results are based not only on the aforementioned behavioural hypothesis, but also on assumptions regarding the market, some of these being that transactions are costless, that property rights are well defined, that markets are competitive, and that markets are perfect.

The first result is extremely important. It had tremendous consequences for policy formulation mostly on the North American continent. From a descriptive approach, a shift was made toward a normative approach (e.g., anti-trust or anti-monopoly laws). The second result is important in the sense that economic efficiency can be promoted without consideration for its redistributive impact, which can be addressed separately. For instance, any "efficiency enhancement" policy (e.g., the enterprise allocation program for codfish in Atlantic Canada in the late 1970s) can theoretically be implemented regardless of its redistributive impact. The appropriation of the fruits of the efficiency program and its redistribution (i.e., through taxes and transfer to unemployment insurance) are separate matters that do not, in a traditional economics framework, have to be bundled with efficiency considerations. This can also be extended into inter-temporal frameworks.

Modelling interactions: non-cooperative game theory

Just as operations research (i.e., the resolution of constrained maximization problems) has been extensively used by traditional economists to model individual behaviours, before aggregating these results to find the collective outcomes, game theory has been used to model interactions between agents. As Krepps (1990, p. 1) puts it, "the basic notions of non-cooperative game theory have become a staple in the diet of students of economics." In non-cooperative game theory, agents are analysed in terms of the rules (or incentive structure) they are facing and the strategy that they will use in order (yet again) to do as well for themselves as possible, assuming that agents cannot enter into cooperative agreements.

Applying the framework given by traditional economics to CPNRs

Traditional economists realized that the market does not always achieve an optimum in the Paretian sense. This has been identified as the case for CPNRs. This failure to achieve an optimum was dubbed "market failure" (cf. Bator [1958] for an inventory of market failures and their consequences). This led, first, to an interpretation of the CPNR "problem;" then, it led to a policy prescription to solve the CPNR "problem." Most of the argument used to analyse so-called "market failures" is built on the concept of externalities.

Pigou (1932) was one of the first economists to address systematically the impact of an agent's (modelled) behaviour on another agent. By drawing a distinction between the "social product" and the "private product," Pigou (1932, pp. 131-135, 183-203) demonstrates that state intervention through taxation (termed "Pigouvian taxes") was essential to "maximize the national dividend."

The linkage between the concept of externality and CPNRs was formalized by Gordon (1954) and, later, in an intertemporal framework, by Scott (1955). Gordon proves that, under open access, fisheries will be exploited inefficiently. The reasoning is as follows. When deciding whether or not to enter a fishery, economic agents will compare the cost of entry to the benefits that they can get. If the cost of entry is lower than the benefits, agents will enter the fishery. What agents do not take into consideration is that, when they enter the fishery, they impose a cost on other fishers (i.e., an external cost or externality) by subtracting resources from them. Gordon identifies two results. First, there are too many persons involved in the fishery (i.e., fewer fishers could catch the same quantity of fish) and productive resources are, therefore, misallocated. This has as an effect that the potential rent (and, therefore, its contribution to what Pigou calls the "national dividend") that the fishery could generate is dissipated. Second, because fishers do not have a guarantee on their catch, although they may want to leave fish for the future, they will have the tendency to take fish beyond sustainable quantities. This led to the policy prescription that access be limited and regulated by the state. Again,

there is a distinction between what society can potentially have and what the private individual can have; and the state is the solution to the externality "problem" through its regulatory power. In terms of property rights structure, this can be analysed as a control by the state of management and exclusion rights.

A second school of thought – later called the property rights school (Arrow 1984) – has another interpretation of the natural resource externality "problem." This school was essentially inspired by Coase's (1960) concept of "the problem of social cost." Analyzing the "problem" of externalities, Coase demonstrates the following results. Provided that rights are well-defined and provided that transactions are cost-less, in the case of externalities, agents will negotiate to achieve a Pareto-efficient outcome. This implies that state intervention through regulations or taxation is not necessary. Central to this result is the proviso that rights are well-defined. If they are not well-defined, the solution could, therefore, be to define them (e.g., privatize a CPNR). This is fundamental in the sense that it leads to conclusion that the "problem" can be adressed through a better definition of property rights. Here, again the "problem" is defined as an externality problem; nevertheless, instead of the state's intervention (central control) as a solution, what is proposed is a (re-)definition of property rights that would allow for a totally decentralized bargaining process (the market), and the efficiency criterion is more akin to Paretian efficiency.

Modelling interactions: applying game theory to the CPNR "problem"

The application of non-cooperative game theory to CPNRs is quite straight-forward. The story line could be the following. Two herders can each choose between putting one cow or two cows on a common pasture. They cannot communicate. While they would be both better off putting one cow each, the incentive structure is such that the outcome will be that both herders will put two cows, leading to a result that is non-Pareto efficient. Such a game, where agents cannot communicate, and where the incentive structure is such that each agent will take the "wrong decision," are called "prisoners' dilemma."

A pseudo-synthesis of this approach to CPNR analysis can be found in Hardin's (1968) "The Tragedy of the Commons." Hardin did not present any new results, but rather an over-simplified synthesis of CPNR economics. Presenting a "common" "open to all," Hardin shows that it can only be mis-managed, the pursuit by individual agents of their personal interest leading to the "tragedy of the commons." Concluding his paper, Hardin advocates the intervention of the state or the privatization of the commons as the sole solutions.

The application of the framework that is described above to CPNR exploitation leads to the conclusion that the resource would inevitably be exploited inefficiently and unsustainably. Typically, the CPNR "problem" is presented as a prisoners' dilemma

game. The story changes, but the structure and the outcome are the same. This leads to two types of recommendations: either the intervention of the state or the privatization of the resource.

The intervention of the state is justified both on efficiency grounds and on sustainability grounds. To address the efficiency "problem," the state can tax agents an amount equivalent to the external cost that they impose on others so that the agents have to consider these costs in their decision making (thus internalizing the externalities that they impose). To address the sustainability issue, the state can fix the limit over which the resource cannot be exploited. This fixes a new constraint on the economic agents, thus changing the operations research problem that they are facing. Furthermore, the taxation of the external cost may allow equity issues to be addressed, the state being able to reallocate the monies from the taxes.

The privatization of the resource can also be justified on efficiency grounds and on sustainability grounds. If the resource is privatized (defining clearly the property rights on the resource and allocating these property rights to individual agents), agents will be able to negotiate its use through the market; therefore, allocative (Paretian) efficiency will be attained. By privatizing the resource, one gives the agents a guarantee that they will benefit from their investment in the resource (a form of investment being to limit the subtraction to exploit the resource later). The operations research problem that agents

are facing, instead of being a one-period problem, becomes a multi-period problem. Furthermore, this allows the equity issues to be considered separately from the efficiency issue (see the section on "Some striking results").

This approach conceptualizes CPNRs exploitation through a powerful "metaphor" (Ostrom 1990, p. 21, Vandermeer 1996), the so-called "tragedy of the commons." Furthermore, as a solution to the "tragedy," promoters of this paradigm propose "piggybacking" on institutions which seem to have a solid track record in avoiding "tragedies."

II.3 Limitations of the " traditional economics" paradigm

The approach that has been described above can be used to understand some of the "tragedies" observed in CPNR exploitation. The collapse of the Pacific sardine fishery (McHugh 1972) and the collapse of the Antarctic blue whale fishery (Clark 1977) are two instances where individuals involved in the use of a CPNR had little mutual trust, were incapable of entering into a cooperative dynamic, and were thus unable to jointly monitor their activities (Ostrom 1990). In these cases, the structure of the prisoners' dilemma can help explain the final outcome.

Nevertheless, the neoclassical approach to modelling economic behaviours has some limitations which will be addressed next. First, there is the issue of clearly defining common pool resources. Secondly, there is the question of cooperation. Thirdly, there is the issue of behavioural hypotheses. Fourthly, there is a growing body of empirical evidence that the "tragedy of the commons" can be avoided. Finally, the "second-best theorem," which demonstrates that it is not desirable to search for Pareto efficiency on one market when it cannot be reached on another market, led to a broader questioning of economics when applied to CPNRs.

Defining the problem at hand

When conceptualizing natural resources management, a central element is defining who has access rights to, or withdrawal rights on, the resource. Several terms have been proposed to describe situations where everyone is granted access and withdrawal rights. Gordon (1954), Hardin (1968), and Scott (1955), for example, use the concept of common property as equivalent to open access (a situation where access and resource withdrawal rights are granted to everyone). Several authors, who make the distinction between an open access resource and a common property resource, contest this view. For these authors (e.g., Baland and Platteau 1996, Bromley 1991), the distinction lies in a fundamental difference: while open access is a situation where an access right is granted to everyone, a common property resource refers to a resource where an exclusion right

is granted to a specific group. This is not just a question of semantics; it is generally accepted that Hardin's tragedy, for instance, will happen in open access situations. Furthermore, using phrases such as "common property resource" or "open access resource" poses the problem that these encompass both the resource and the way it is managed.

Ostrom et al. (1992) propose the definition that is used throughout this dissertation. It is possible to distinguish between an open access common pool resource (cf. Gordon [1954] and Hardin [1968] on "common property resource") and a limited access common pool resource (cf. Baland and Platteau [1996], and Bromley [1991] on "common property resource"). Ostrom el a. (1992) approach to the definition of CPNRs has two interesting features. First, it encompasses both open access and limited access common pool resources. Second, this definition does not presuppose the existence of a resource management institutional arrangement.

Cooperation

Through several features, the approach that is described above (i.e., traditional economics) rejects the notion of cooperation. By ascribing a very limited set of decision making criteria to the economic agent, by modelling aggregate behaviours in terms of the sum of individual behaviour, and by a systematic reliance on the notion of competition

through the market, the traditional economics approach does not take into account the fact that once there is more than one individual involved, the type of relationship between agents can change individual behaviours. For instance, Axelrod (1981, 1986, 1990) and Axelrod and Dion (1988) show theoretically and empirically that a prisoners' dilemma game repeated with an indefinite ending may have an efficient outcome. This again is a powerful result because real world interaction may be repeated. The basis of the argument lies in the premise that players may infer other players' behaviours from past moves. Another instance is Sen's (1967) assurance game which allows communications while having the same incentive structure as a prisoners' dilemma. Again, one can demonstrate that the outcome of such a game may be efficient.

Behavioural hypotheses

This questioning of traditional economics lies in the criticism of its underlying behavioural hypothesis. A first level of criticism stemmed from the works of Simon (1955, 1956, 1957). For this school of thought (e.g., Attali and Guillaume 1974, Wiles 1983), the fact that individuals are optimisers is unlikely. For another school (e.g., Rose 1994, pp. 30-35), it is the variable affecting the objective functions used to model behaviours that are too restrictive. Acknowledging individuals for whom decision making is not a maximization problem, or for whom the goods and services they use are not their major decision making criteria, has as a consequence that the results of

traditional economics do not stand anymore: the market does not lead to allocative efficiency. It must be noted, however, that this does not address a central question: are the market or the state capable as institutions of managing CPNRs?

A refinement of this criticism of the behavioural hypothesis lies in the critical analysis of the concept of externality. When defined, the term "externality" is linked with the effect of one (or several) agent(s) on one (or several) agent(s), this effect not being mediated through the market. The "external" in externality is linked with the "location" of the effect, but, when analysed by traditional economists, the "problem" of externalities is not linked to the "location" of the effect anymore. It is linked to the fact that these so-called externalities are external to the decision-making criteria used by economic agents as defined by traditional economics behavioural hypotheses. There is a huge ethical gap between the identification of the effect and the way it is treated. Swaney (1981), for instance, compares the concept of externality with the concept of community and shows how traditional economics' treatment of externalities results in the concepts of community and externality being mutually exclusive.

Spatial issues

Social dilemmas do occur in space (Nowack et al. 1994). Nevertheless, the classical/ neoclassical approach neglects the spatial dimension by using the assumption of costless

transportation. Furthermore, when analysing resources, the spatial dimension is linked with the potential for resource mobility and storage, through space (Schlager et al. 1994). Spatial issues are, therefore, fundamental and an a-spatial model may not be the most appropriate.

Empirical evidence

Evidence that CPNRs can be managed without state intervention or extreme privatization led to a further criticism of traditional economics. A first set of empirical evidence comes from experimental designs. For instance, evolution in game theory led to a series of experimental designs to assess the impact on games of the lifting of some of the assumptions defining the prisoners' dilemma. Axelrod (1981) uses computer models to simulate infinitely-repeated prisoners' dilemma games. This allows him to demonstrate that very simple reactive strategies (e.g., "Tit for Tat" strategy) would lead to Pareto-efficient outcomes. Simmons (1980) shows that lifting the assumption of non-communication had a definite effect on increasing the number of Pareto-efficient outcomes. This is confirmed in various experimental settings with costless communications (e.g., Braver and Wilson 1986, Hackett et al. 1994, Ostrom and Walker 1991, Ostrom et al. 1994), as well as in experimental settings with costly communication (Ostrom et al. 1994).

As demonstrated earlier, most traditional economists analyse CPNRs as if there could only be open-access CPNRs. The observation of the "disastrous results" (in terms of sustainability [Mathews 1993] or in terms of equity [Greer 1995]) of market- and state-based CPNR management can be attributed to this over-simplification of the concept of the commons. The ignorance of the existence of other institutions is often identified as a major cause for the catastrophes: the reckless privatization/regulation of commons which where successfully locally managed, led to the collapse of the local institutions, leading to the collapse of the resource (McCay and Acheson 1987). Acknowledging the existence of an arrangement other than open access or complete privatization was, therefore, a major step in the progress of the understanding of CPNR management. While this has been achieved on a theoretical level by Ciriacy-Wanthrup and Bishop (1975), the distance between academic recognition and policy design is big enough to have impeded the use of the concept of the commons for policy design until the early 1990s when, for instance, community-level resource management was actively encouraged by donour agencies in the Global South (Marty 1996, Painter et al. 1994, Thébaud 1995).

The recognition by anthropologists of the success of other institutions than the state or the market to manage CPNRs (cf. Forman 1969) came even before Ciriacy-Wanthrup and Bishop's (1975) paper. Progress in economics, pointing to the possibility of alternative arrangements for CPNR management (Seabright 1993), combined with the

failures of traditional approaches to CPNR management (i.e., state control or reliance on the market), gave rise to an interest in local or community resource management. This led to a body of literature that can be divided in three broad sections. One, more conceptual, addresses the question of collective action and the determinants of its success (the synthesis of which can be found in Section II.4). The other consists of a huge (and ever-growing) quantity of case studies, or case study compilations, focussing essentially on descriptive analysis of local CPNR management (e.g., Bjorklund 1990, Blair 1996, Bodner 1994, de Haan 1995, Drijver et al. 1995, Hviding and Baines 1994, Little 1994, Metcalfe 1995, Strum 1994, van Beek 1995, van Dijk 1995, Zerner 1994). A third field of enquiry consists of recent developments in cooperative game theory (McCarthy 1998, forthcoming, McCarthy et al. 1998, 2001).

Finally, this widespread empirical evidence of the existence of locally-managed non-privatized CPNRs has led some authors to explore the rationale for their existence. Van den Brink et al. (1995), for instance, demonstrate that the existence of property rights consisting of private property for agricultural land and of non-privatized CPNR for rangeland in the Sahel can be considered as a rational adaption to rainfall variability.

"Second-best theorem"

The basis of the "second-best theorem" stems from Lipsey and Lancaster (1957). They

demonstrate that it is not desirable to search for Pareto-optimal conditions in one market when a non-optimal situation exists in other markets. This can be considered as a very powerful critique of the traditional economics approach. For instance, any marginal taxation scheme will induce distortion in the labour market, therefore making the search a first-best solution condition on any other market useless (Price 1977, pp. 32-33). The question stemming from the "second-best theorem" is, therefore, does it make sense to analyse economic activity in terms of objectives that are worth achieving only in theoretical situations?

While this "impossibility theorem" had a definite impact in carrying "so much further the process of disillusion with conventional welfare economics" (Mishan 1981, p. 14), some did argue that its impact has been somehow belittled by the following arguments.

First, while the second-best theorem demonstrates that a Pareto-optimum condition may not be what one searches for when analysing a single market, it does so by taking into consideration supplementary constraints (Layard and Walters 1978, pp. 180-182) to the optimization problem (which is actually the mathematical trick used by Lipsey and Lancaster [1957] to demonstrate their "second-best theorem"). One can actually not expect an operations research problem solution to remain unchanged by the multiplication of constraints and by the consequent complexification of the question studied (this seems a posteriori to be obvious). Therefore, second-best theory only points

to the fact that the optimization problem needs to be reviewed and that, under these revisions, another first-best solution may be found, this solution being a Pareto optimum. Nevertheless while the search for an optimum is still possible, this search will be misguided if a single other market is non-Pareto optimal.

Second, it has been argued that some industries may very well have all their activities linked with the sector of the economy satisfying first-best conditions. This seems wishful thinking at best when considering the markets for labour and for energy which are typically imperfect.

The second-best theorem remains, therefore, important because it stresses several characteristics of the traditional economics approach that make it less relevant to the analysis of complex "real life" situation similar to CPNRs. When applied to CPNR management, second-best theory has been proposed to analyse situations where the search for a social optimum may lead to a non-Pareto outcome for reasons linked to the cost of gathering of information necessary to implement the policy change linked to the attainment of the first-best or social optimum (e.g., Mas-Colell et al. 1995, pp. 368-374).

The second-best theorem is particularly relevant to the analysis of CPNR access limitation schemes. The costs (due to labour market imperfections, for instance) of compensating excluded individuals needed to achieve a Pareto optimum may very well

offset the gains from increased efficiency. Comparing the gains from efficiency with the implementation of redistribution can lead to the conclusion that the implementation of efficiency enhancement programs may not be worth the cost (due often to imperfections in the labour market due to institutional factors) of the necessary redistribution. This issue has been addressed mostly in fisheries management, e.g., Campbell 1989, Crutchfield 1979, Dupont and Phipps 1991, Grafton,1992. For instance, using a neoclassical approach, this writer (Vanderlinden 1996) argues that major efficiency gains (more than 7 million dollars yearly) could be achieved in Atlantic Canada's lobster fisheries, assuming first-best conditions on all markets. However, such a policy change (further reduction of the access to the fisheries) would involve human and administrative costs that are most likely to offset any efficiency gains. In the traditional economics sense, lobster fishery management in Atlantic Canada may very well be a second-best policy and does not need to be transformed using traditional economics techniques as a tool to define an objective.

II.4 Analysing community-level CPNR management

As has just been demonstrated, one of the dominant frameworks in the field of CPNR analysis, namely traditional economics, fares poorly in terms of understanding community- level CPNR management. The purpose of this section is to describe briefly

some of the results obtained by using approaches that are alternatives to traditional economics. The literature on successful community-level CPNR management focuses essentially on the identification of its determinants through the analysis of evidence from experimental designs and/or case studies.

When studying self-organized and self-governed collective action for CPNR management (i.e., local management institutions), the central question that one has to answer is the following: how does a group of individuals who are in an interdependent situation manage to organize and govern themselves in order to secure a common income stream? This question can be divided into three sub-questions (Ostrom 1990, pp. 29, 42-45).

First, what are the initial conditions that increase the likelihood of successful collective action? This question is mostly concerned with the issue of the provision of (a) new institution(s). This is a particularly difficult question to address because even if it is clear that every member of the concerned group will benefit from the new institution, there may always be an incentive not to contribute to its provision.

Secondly, what are the conditions for collective action to be sustained over time? This question is mostly concerned with the issue of credible commitments.

Thirdly, what are the variables that will allow local collective action to be autonomous (i.e., not requiring any kind of external assistance)? This last issue is intimately linked with the former one. The "solution" to the issue of credible commitments that is often proposed is external enforcement. Here, what communities need is mutual monitoring. Mutual monitoring is also part of the institutional design (see first question above) and may, therefore, be problematic to provide.

Ostrom (1990, p. 188) identifies the following characteristics as having a definite impact on a CPNR local management outcome: group size, similarities of interest, the presence of participants with substantial leadership, and social capital. How these different characteristics have been treated in the CPNR literature will now be briefly reviewed.

Group size

The issue of group size was originally considered by Olson (1965), who demonstrates that the provision of public goods is only possible in "small" groups (i.e., the size of a group not in terms of numbers, but in terms of how well individual actions are noticed by the group), and that "large" groups are doomed to be unable to provide a public good without some kind of coercion, while groups of "intermediate size" may or may not provide a public good. Since Olson's work, there seems to have been a general agreement that group size is fundamental: the smaller the group, the better the chances

for successful collective action (e.g., Bardhan 1993). Nevertheless, this view does not seem to be supported by empirical evidence and may be the result of a simplistic analysis of the effect of size (Snidal 1995). Reviewing case studies where collective action for the provision of a local management institution was successful, Ostrom (1990), and Baland and Plateau (1996, pp. 298-302) show that the size of these groups can be large and variable. Reviewing the literature on experimental analysis of group size effects on game outcomes, Franzen (1994) shows that the structure of the game is far more important than group size.

Heterogeneity

It is generally agreed upon that heterogeneity impedes collective action for the management of commons (Bardhan 1993, Libecap 1995). One must nevertheless give precision on the "type" of heterogeneity considered. Baland and Plateau (1996, pp. 302-303) identify three "origins" for heterogeneity: cultural differences, differences in the nature of the interests agents have in engaging in collective action, and differences in endowments. The two first sources of heterogeneity are considered by Baland and Plateau as the two most threatening to collective action, while the third does not seem to have a clear impact with regard to collective action. Heterogeneity's impact on collective action is still being investigated.

Social capital

Social capital, defined as "the arrangement of human resources to improve flows of future income" (Ostrom 1995) can take several forms: institutions, networks, norms, and social belief (Ostrom 1990, 1992, 1995; Putnam 1993). The sharing of norms and social belief is mostly identified as the "kind" of social capital that can have positive impact on the crafting of local institutions for CPNR management, while the existence of successful institutions in other realms of the community's activities can be a good indicator of a proven capacity to self-organize. The concept of social capital for CPNR management is recent enough to still be the subject of a rapid evolution. Social capital as a concept is being explored and a clear analytical framework needs to be developed.

II.5 Co-management as a middle way

As noted above, traditional economics' major point regarding CPNR management is that it can be achieved only through control by a central state or complete privatization. Nevertheless, empirical evidence led to the alternative view that local users could manage their CPNRs. A fourth option will be briefly presented here: co-management.

Co-management structures, as institutional arrangements allowing the sharing of CPNRs

management between central states and local users, have been defined in various ways. While some define co-management using their case study(ies) as some sort of "ideal type," others try to propose a definition encompassing all instances of co-management. Witty (1994, p. 23) proposes the following definition:

> Shared resource decision making by interested and affected parties (primarily for the benefit of the local communities) as defined within a broader regional and provincial cooperative framework that recognizes the importance of cultural and natural values, while seeking to minimize disconcerted views on the allocation, the management, use, protection and preservation of natural resources through accountable implementation.

Roberts (1994, p. 28) proposes the following definition:

> Co-management is a joint management process that brings together local resource users and government representatives to share responsibility for the management of local or regional resources.

While Berkes et al. (1991, p. 12) stress the following:

> "There is no widely accepted definition of co-management. The term broadly refers to various levels of integration of local- and state-management systems."

The combination of the two first definitions seems to encompass all co-management case studies found in the literature. Two elements in these definitions need to be stressed: first, the "primally for the benefit of the local communities" of Witty's (1994) definition, excluding therefore co-management between interested parties sharing the benefit of the resource exploited through corporate arrangements; and second, Roberts' (1994) phrase "of local or regional resources" which exclude global commons, for instance. Berkes et

al. (1991, p. 12) warn against being too precise when defining co-management as:

> "there is a continuum of co-management arrangements from those that merely involve, for example, some local participation in government research being carried out, to those in which the local community holds all the management power and responsibility."

Pinkerton (1993) shows how new social movement theory may shed a light on a specific instance of co-management, the Tin Wis Forest Stewardship Acts. Chouinard and Vanderlinden (1997) use contractarian analysis to analyse a watershed-level instance of co-management. Singleton (1998) analyses co-management from an institutional evolution and trust building perspective. Singleton (1998, p. 143) demonstrates that co-management allows for a "productive division of labor," by allowing the use of the respective strength of local communities and state agencies. Despite these instances of development in co-management theory, many authors limit their analysis to one or several case studies, trying to draw lessons for institutional design. This leads to a great variety of the identified determinant of a successful co-management scheme, a sample of which may be found in Chouinard and Vanderlinden (1997).

In terms of property rights, co-management can be interpreted as following: the management right is vested in the co-management structure which will define access and the withdrawal rights holder(s). This can be seen as middle way between state or

external control and community-level control (Baland and Platteau 1996).

II.6 Approaching CPNRs

The four sections above lead to two conclusions. First, CPNRs have been approached in several different ways, each leading to different options in terms of management. Second, CPNR analysis is complex and necessitates that disciplinary boundaries be crossed.

The first conclusion means that, when approaching CPNR analysis, it is important not to consider that there is only one way to manage CPNRs. The second conclusion stems from the first: analysing CPNRs leads to the necessity of answering some key questions. These questions are the following. Is the CPNR under scrutiny an open-access CPNR? Does the fact that the CPNR under scrutiny is not privatized serve a purpose? What are the linkages between local institutions and the external environment? Are there already existing institutions that could serve as management agencies? In order to answer these questions, which involve the natural environment, the economic environment, and the social environment, several disciplinary fields are needed. Alternatively phrased il is possible to say that social and natural systems must be linked (Berkes and Folke 1998).

The case study here, the context of which follows, will serve as an illustration of these two conclusions. Furthermore, it will allow an exploration of the means that have to be used when crossing disciplinary boundaries for the purpose of CPNR analysis.

CHAPTER III: PROPERTY RIGHTS, RISK, AND LIVESTOCK DEVELOPMENT IN NIGER – THE STATE OF THE ISSUE[1]

The purpose of this chapter is to show how property rights on the land, rainfall risk, and livestock development are intimately linked to CPNR management analysis, using the case of Niger. A brief introduction to the linkages between rainfall risk and property rights will be followed by a description of the issues that are faced by property rights and livestock development in Niger. While land tenure, risk, and livestock mobility in sub-saharan Africa are the subject of an extremely rich literature (e.g., on land tenure, Agbosu 1988, Atwood 1990, Basset 1993a, 1993b, Berry 1988, Besteman 1994, 1992, Bruce 1988, 1993, Bruce and Migot-Adholla 1994, Cheater 1990, Cissé 1982, Goheen 1992, Kintz 1982, Lund 1996, Migot-Adholla et al. 1991, Moorehead and Lane 1995, Morton 1996, Peters 1992, Place and Hazel 1992, Platteau 1995, 1996, Saul 1988, 1993, Shipton and Goheen 1992, Sjaastad and Bromley 1997; on risk, Bernus 1988, Bromley and Chavas 1989, Carter 1991, 1997, Carter and Zimmerman 1994, de Garine and Koppert 1988, Matlon 1990, Stewart 1990, Watts 1998; and on livestock mobility, Behnke and Kerven 1994, Behnke and Scoones 1993, Moorehead 1998, Niamir Fuller 1998, 1999, Turner 1998, 1999a, 1999b),the focus of this section will remain mostly on the literature pertaining specifically to Niger.

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[1]Earlier version of parts of this chapter are presented in Vanderlinden (2000b).

III.1 Rainfall variability-mobility-tenure linkages

Rainfall variability is often identified as the major environmental risk faced by agro-pastoralists (e.g., Swallow 1994). Among the many risk management strategies that are identified, livestock mobility is seen by many authors as a key approach to rainfall risk management by agro-pastoralists (e.g., Behnke and Kerven 1994, Behnke and Scoones 1993, Fleuret 1986, Moorehead 1998, Niamir Fuller 1998, 1999, 1999b, Painter et al. 1994, Swallow 1994, Turner 1998, 1999a, van den Brink et al. 1995). Sivakumar (1987) and Sivakumar et al. (1993) show that one of the major climatic characteristics in Niger is rainfall variability and the recently increased frequency of rainfall shocks (droughts).

In Niger, land tenure consists of a mix of quasi-private and common property allowing both fixed agricultural production and mobile cattle raising. Nevertheless, the combination of population increase, low and variable rainfall, and changing institutional environment creates a stress on land tenure systems. Since 1993, the Niger government has begun implementing a new rural code which should redefine the access, the use, and the management of Nigerien natural resources (Secrétariat Permanent 1993, 1997). This calls for a clear understanding of how rainfall variability and the use of land for agricultural and pastoral activities must contribute to a (re-)definition of land tenure in Niger. While property rights, risk, and livestock development form a nexus that may

seem artificial to untangle, beginning by separating these issues allows the identification of their linking element in Niger: livestock mobility. This section reviews separately the current knowledge on land tenure and livestock development in Niger linking these to recent climatic evolution.

III.2 Land tenure and property rights

Land tenure in Niger is under stress. A first source of stress is the changing natural and demographic environment, while the second source of stress comes from political changes.

A first source of stress: the population-environment nexus

Land tenure systems mediate the relationship between humans and the resource (Schlager and Ostrom 1992). Once this relationship is under stress, the mediating institution is also under stress. For instance, Grégoire (1982) shows that the increase in population led to the increase of the cultivated area in the village of Gourjae in eastern Niger (while numbers that are specific for Gourjae are not available, population growth in Niger has consistently been larger than 2.5% for the past 20 years). This stressed the local land tenure system and led to an adaptation of pastoral practices and the creation of rainy

season livestock corridors, thus changing some of the rules regarding land use.

This population increase, which occurs in an area prone to drought and desertification (Arrignon 1987, pp. 4, 7-22, Agnew 1995), may lead to further degradation of the land resource base. The increase in population, when combined with the decrease in the land resource base in terms of quality, leads to greater relative and absolute scarcity of agricultural land. Agriculturalists claim more agricultural land, pushing pastoralists on to highly fragile marginal land (Cleaver and Schreiber 1994, pp. 21-24; for detailed Nigerien case studies, Colin de Verdière 1995 and Banouin et al. 1996).

The effect of the population growth is combined with a trend of increased rainfall variability and decrease in absolute rainfall quantity which seem to be linked with long-term global climatic cycles. Comparing the long-term average of rainfall before 1969 and after 1969, one can see that the 400 mm isohyet moved from 15th parallel to the 14th (Sivakumar 1987). This pattern is accompanied by an increase in variability.

A second source of stress: changing politics

The impact of colonization on agricultural land tenure can take several forms. For example, the use of local authorities by the British colonial administration to exercise an indirect control over land in East Africa led to a weakening (sometimes due to their

"reconstruction" [Cheater 1990]) of traditional institutions (Berry 1992). On the other hand, the nationalization of the *terres vacantes et sans maître* in Francophone coastal west Africa and their dedication to cash crops is another instance of deep transformation imposed by the colonial power. Nevertheless, the impact of the French rule in Niger on agricultural land tenure is not very important. This can be explained by the fact that Niger, because of its unfavourable environmental conditions (i.e., low and variable rainfall, poor soils), was only seen as a reservoir for labour. Land, in Niger, was a secondary concern for the colonial power (Raynault 1988).

When considering rangeland, it is difficult to assess the impact of the colonial rule in Niger on range land tenure *stricto sensu*; however, the colonial power had an important impact on pastoralists' traditional institutions. For instance, the social organization of the Twareg Kel Dinnik pastoralists went through deep transformations. From vertically-integrated socio-economic structures, essentially based on slavery, able to withstand important environmental variation, a shift occurred toward smaller scale and riskier cattle raising (Starr 1987). A decrease of resiliency to exceptionally low rainfall leads to a greater reliance on livestock mobility to manage rainfall risk both for pastoralists and agro-pastoralists (e.g., Amoukou et al. 1996). This greater reliance on mobility leads to greater needs in terms of access to range resources. This may lead to a shift in terms of needs for tenure systems.

Originally, land tenure in Niger's agro-pastoral area was characterized by the existence of three different types of tenure status. Up to the time of independence, landowners, composed of aristocratic and warrior families, held a primary ownership right (i.e., village chief and their lineage, canton chiefs and their lineage). They could allocate land and receive tithe payment. Their control over land was attributed to the fact that they were members of the families who arrived first on the land considered. Use-rights holders formed a second group. Having a secondary ownership right (i.e., they received land from the village and canton chiefs), they had to pay tithes. Their use-right was secure and could be inherited by their children. A third group was formed by tenant farmers, renting fields and being vulnerable because the owners could reclaim their field at any time (Ngaido 1993a, 1993b).

Following independence, the first regime (Hamani Diori 1960-1974) abolished tithe payments and recognized customary ownership. This created two classes of land owners: nobles and aristocrats, who saw their customary rights recognized and, therefore, could alienate land in their possession; and the use-rights holders and the tenants who, through the suppression of the payment of the tithe, were considered de facto owners (non-payment of the tithe being the sign of ownership), but could not alienate or divide their land (Ngaido 1995). It must be noted, however, that a majority of tenants and use-right holders continued to respect their traditional obligations and were, therefore, not considered as owners. The second regime (Seyni Kountché 1974-1987 and Ali Saïbou

1987-1990) introduced a "land to the tiller" policy that was supposed to increase tenure security to use-right holders and tenants, but which was not supported by any legislation (Ngaido 1995). Again, many use-right holders and tenants kept on paying the tithe, asserting therefore the fact that they were not owners (Lund 1996). Following the demise of the Kountché military regime, traditional landowners began to reclaim land that was lost during the "land to tiller policy period;" their task was facilitated by the lack of a legal framework supporting this policy. The final result of these successive reforms was a confusion in terms of land tenure, generating tension and increasing conflicts over land tenure (Ngaido 1995). Presently, while an initiative (the *code rural*) to redraft land tenure related legislation is being implemented (stalled according to some, e.g., Gado 1996), village and canton chiefs remain de facto the principal authority regarding land allocation decisions; customary tenure arrangements still prevail (Gavian and Fafchamps 1996). In terms of tenure security, owners and use-right holders can be considered as having a secure tenure over land, while tenants always face the risk of losing their fields.

When considering rangeland, it must be noted that, since 1959, Niger has been divided into two areas: one, where agricultural activities are theoretically mostly prohibited – the *zone de modernization pastorale*; the other, where agricultural and pastoral activities are supposed to coexist – the *zone agro-pastorale*. Most of the following paragraphs concern the *zone agro-pastorale* which encompasses all of the geographical area where the present research has been conducted.

Rangeland consisted, up to independence, of uncultivated areas under the control of the village chief (fallows) or canton chiefs (land that has never been cultivated). These lands were considered as *terres de chefferies* (i.e., land of the traditional chiefs). Under the Diori regime, the *terres de chefferies* were nationalized if they had never been cultivated in the past or were considered as common village land when it was fallow land (Ngaido 1993a, 1993b). Under the Kountché regime, the nationalization of virgin land was confirmed, while the status of fallow land was left unclear. After the Kountché regime, more rangeland was allocated to farmers (for cropping) by village chiefs. This allowed the traditional authorities to assert their "traditional right" over these lands (Ngaido 1993b). It must, therefore, be stressed that, at the present time, rangeland is under control of groups with a strong agricultural tradition.

Concerning present use, during the rainy season, any uncultivated land can be used as pasture land (although it is not necessarily used as such). During the dry season, all fields are open for grazing on the residues (Williams 1997). This illustrates the fact that property rights are defined seasonally (Ngaido 1993a).

More recently, concerns have been raised about the impact of development policies on land use and land allocation to range. An example of development policy that has been under scrutiny is the *terroir* approach. The *terroir* concept is an approach to land use planning by development projects that has, in recent years, been favored by French

development agencies and by governments of former French colonies in the Sahel (Elbow 1996). It was originally an analytical unit describing the physical space from which sedentary villagers get most of their means of subsistence. This analytical unit is now used as an intervention unit in a drive to give rural communities a greater responsibility in the management of their resources. Although it may be too early to assess the impact of the *terroir* approach on land tenure, some elements need to be highlighted here. Because it has essentially been used as a concept linked with sedentary agriculture, the concept of *terroir* is not compatible with a highly mobile lifestyle (Marty 1996, Painter et al. 1994). There may be a real risk that the exclusion of a mobile population from the current mainstream development paradigm contributes to a further transformation of land tenure arrangements that were traditionally adapted to mobility (e.g., existence of a corridor for transhumant livestock).

To summarize, the current situation of land tenure in Niger is characterized by the existence of traditional tenure arrangements that are facing the challenge posed by population increase, rainfall variability, and changing political environment. There seems *a priori* to be a shift from a tenure system geared toward an equilibrium between pastoral and agricultural activities to a system geared toward agricultural activities. This is mainly attributed to an increasing relative and absolute arable land scarcity combined with a growing importance of agriculturalists in the local political sphere. Following the droughts in 1973-1974 and 1981-1982, pastoralists lost most of their cattle through death

or sale to other segments of the population (Habou and Danguioua 1991, White 1987). This marginalization of pastoralists in terms of land tenure occurs, therefore, in particularly difficult times.

If one analyses land tenure in Niger in terms of the rights and duties associated with the tenure system, one could summarize the situation as presented in Table III.1. The bundle of rights associated with the use of land is defined seasonally and involves actors at different levels. In terms of the tenure of land, there is a mix of use-right and private property. In terms of the resources (i.e., forage, crop), there is a mix of private property, common pool resources, and open access resources. The simultaneous existence of different property rights structures seems to indicate that there are ways for agriculturalists or pastoralists to appropriate CPNR to themselves.

III.3 Livestock raising

While livestock represented a major contribution to Niger's economy in the past (i.e., more than 80% of Niger's agricultural exports up to the early 1970s), the successive droughts as well as the influx of money due to the "Uranium Boom" of the 1980s[1]

[1] In 1980, uranium accounted for 80% of Niger's annual exports, or roughly US $ M 450 (UNCTD 1999).

Table III.1: Schematic description of land tenure arrangements in southwest Niger (sources: Ngaido 1993a, b,Williams 1997)

	Rainy season		Dry season	
	Range resources (fallow and bush)	Land for agriculture (cultivated land)	Range resources (fallow and bush)	Land for agriculture (land cultivated the preceding rainy season)
Access right	Granted to everyone provided that pastoral activities do not interfere with agriculture (negotiation with the village chief)	Granted to the usufruct right holder	Granted to everyone (negotiated?)	Granted to everyone (negotiated?)
Withdrawal right	Granted to everyone provided that pastoral activities do not interfere with agriculture (negotiation with the village chief)	Granted to the usufruct right holder	Granted to everyone (negotiated?)	Granted to everyone when grazed, under the authority of the usufruct right holder when collected for storage or sale
Management right	Under the authority of the village chief for fallows and canton chief when never cultivated	Management by the usufruct right holder, limited to decision relating to fertilization fallow and well digging	Under the authority of the village chief for fallows and canton chief when never cultivated	Management by the usufruct right holder, limited to decision relating to fertilization fallow and well digging
Alienation right	Under the authority of the village chief for fallows and canton chief when never cultivated	Under primary or secondary right holder's authority	Under the authority of the village chief for fallows and canton chief when never cultivated	Under primary or secondary right holder's authority

somehow reduced this importance up to the mid-1980s. Recently, following the "Uranium Crash,"[2] the progressive diminution of cash crops, and because of political instability in areas normally visited by tourists, the relative importance -- US $ M 20 of exports in 1992 in absolute terms (FAO 1998) -- of livestock has been growing steadily (Colin de Verdière 1995). Livestock raising in Niger is, nevertheless, facing a series of challenges that will be briefly reviewed below.

Transfer of livestock ownership

As White (1987) and Habou and Ganguioua (1991) have showed, the successive droughts in the past 30 years (beginning in 1972-73) led to a transfer of ownership from pastoralists to groups not historically practising pastoral activities (e.g., merchants, government officials, agriculturalists). This transfer of ownership led to a situation where ethnic groups having an expertise in pastoral activities ceased tending herds composed of their own animals. This may have shifted their incentive in managing the pastoral resource; they may also have lost the autonomy of decision making needed to manage rangelands. Furthermore, the arrangements between absentee owners and livestock keepers (payment in kind or in money for the services rendered) did not allow pastoralists to reconstruct their herds.

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[2] In 1990, uranium accounted for less then 15% of Niger's annual exports (UNCTD 1999).

III.4 Community-level rangeland management in southwest agro-pastoral Niger: questions that should be answered

Following the above description of the current situation, it is possible to identify some key questions that should be answered in the course of this research. A discussion of these follows. It must be stressed here that this set of questions is by no mean comprehensive. Many issues will remain unanswered when analysing the linkages between property rights, rainfall variability, livestock raising, and the role of agro-pastoral communities in managing their rangeland. The conclusion of this dissertation will discuss these unaddressed areas of enquiry.

What are the determinants of rangeland use in agro-pastoral Niger?

As White (1987) and Habou and Danguioua (1991) contend, the transfer of livestock from traditional pastoralists to other segments of the population in Niger led to a loss of incentive, or a loss of capacity, for the traditional pastoralists to manage the range. It seems that there is a tendency for traditional agriculturalists engaged in pastoral activities to appropriate the management rights of the rangeland in their village. A first purpose of the modelling exercise could, therefore, be to analyse what are the determinants of range use in order to assess whether it is internally regulated (i.e., managed). The determinants of this management should be identified as well.

What are the determinants of livestock mobility?

As presented above, mobility is analysed in terms of a risk management strategy allowing *ex post* adaptation after inadequate rainfall. Nevertheless, there are other plausible explanations to livestock mobility. Risk management may be one amongst other reasons for being mobile. Livestock mobility gives pastoralists and agro-pastoralists the opportunity to (1) avoid destruction of crops (priority to agriculture, minimization of conflict cost), (2) go to areas where rain onset comes earlier, when rains are late in their own villages (risk management), (3) access an open pastoral space up north (risk management), (4) benefit from better pastures (rent capture), and finally (5) lower the rainy season pressure on the local range (management). Analysing these different rationales will contribute to a better understanding of mobility and its importance in face of rainfall variability.

What is the impact of droughts on land tenure and allocation and is this impact irreversible?

Subsumed in most of the literature on the colonization of pastoral land for agriculture is the assumption that this colonization occurs continuously and irreversibly. Very little is said about the possible influence of droughts in terms of land tenure. Recent droughts and their apparent increase are nevertheless most likely to have a lasting impact (other

than major livestock losses) on land tenure and/or land allocation. Furthermore, the "irreversibility" of the pastoral space marginalization could have an important effect on the way community-level range management is implemented. If indeed rangeland is appropriated by agro-pastoral communities, management could be exercised through the exclusion of outsiders. Nevertheless, this may not be a preferred route to follow as more could be gained by some form of shared management with outsiders (see Turner 1999a). Thus it may be necessary for the pastoral space to "reopen."

What impact may the current local institutional environment have on agro-pastoral communities' role in managing rangeland?

Before attempting to define the role of agro-pastoral communities in managing their rangeland, it is important to assess whether their current institutional environment may be supportive of such a role. An important aspect of this is, of course, the institution of property rights. Nevertheless, this cannot be the only institution under scrutiny. As presented earlier, property rights institutions in southwest agro-pastoral Niger are intimately linked with family relations and, therefore, with the traditional local authority. What is more, manure contracts and transhumance contracts are almost the sole institutions that are mediating communication between traditional pastoralists and agro-pastoralists. These communication institutions could pave the way for communication

for the purpose of rangeland management. These institutions will be analysed as well.

III.5 Approaching property rights, risk, and livestock development in southwest agro-pastoral Niger: conclusion

Property rights, risk, and livestock development in southwest agro-pastoral Niger raise several questions. Rangeland in southwest agro-pastoral Niger is a unique opportunity to try to apply the principle regarding CPNRs identified in Section II.5. The contents of the three following chapters give an opportunity, not only to answer questions directly relevant to southwest agro-pastoral Niger, but also to show how different disciplinary fields can be joined in order to analyse CPNRs.

Chapter IV shows how, using an econometric approach, it is possible to answer the two following questions that were identified in Section II.5. Is the CPNR under scrutiny an open access CPNR? Does the fact that the CPNR under scrutiny is not privatized serve a purpose? For southwest agro-pastoral Niger, these two questions have been rephrased in Section III.4 as the following. What are the determinants of rangeland use in agro-pastoral Niger? What are the determinants of livestock mobility?

Chapter V shows how a historical events analysis allowed the following question that was identified in Section II.5 to be addressed. What are the linkages between local

institutions and the external environment? For southwest agro-pastoral Niger, this question can be seen as the basis behind the following question that was identified in Section III.4. What is the impact of droughts on land tenure and allocation and is this impact irreversible?

In Chapter VI, sociometrics are used in order to answer the following question identified in Section II.5. Are there already existing institutions that could serve as management agencies? For southwest agro-pastoral Niger this corresponds to the following question that is identified in Section III.4. What impact may the current local institutional environment have on agro-pastoral communities' role in managing rangeland?

The three following Chapters focus, therefore, on the case study specifically through the analysis identified above. They will be followed by the conclusion which will allow the integration of the results into one coherent argument.

CHAPTER IV: MODELLING COMMUNITY-LEVEL DECISION MAKING PERTAINING TO LIVESTOCK UNDER RAINFALL VARIABILITY: AN ECONOMETRIC APPROACH[1]

The purpose of this chapter is to identify the determinants of rangeland use and of livestock mobility in southwest agro-pastoral Niger. In order to achieve this, a theoretical model is identified by using recent development in game theory applied to rangeland management McCarthy (1998, forthcoming) and McCarthy et al. (1998, 2001). This theoretical model, summarized by structural equations, is thereafter confronted to field observations in order to specify a reduced form model (reduced form equations). Finally, the estimation of the reduced form equations allow the empirical testing of the relevance of the different determinant that are identified.

The present chapter is divided into 5 sections. The first section presents the survey procedure. The second section presents summary results from the community survey. The third section presents how theoretical development allowed for the development of the theoretical model identifying the determinants of range use and livestock mobility. The third section presents how this theoretical model is confronted to field observation

[1] Earlier versions of parts of this chapter are presented in Vanderlinden (2000b). This chapter benefits from the progress made with the preparation of Vanderlinden and McCarthy (2001). While the author benefited greatly from McCarthy's contribution in the modelling and the development of the cooperation indices, errors and/or omissions are the sole responsibility of the author.

in order to develop a model that will allow for an empirical testing of the relevance of the determinants that are identified. The fourth section explains how the empirical testing was rendered operational and the results that came forth. Finally, the last section discuses the results and presents the conclusions that can be drawn from these results.

IV.1 Survey procedure

Forty villages were surveyed during the dry seasons of 1997 and 1998. The objective of the survey was to gather village-level data on ecology, socio-economics, and institutions. The survey procedure consisted of the sampling followed, for each village, by a participatory mapping, a resource assessment, and a group interview. The survey procedure and the interview framework were first tested in five villages. Following the survey, a livestock price survey was conducted. The survey tools that were developed are given in Appendix 1.

During the village surveys, the author worked in close collaboration with a translator. Because of the complex nature of the data being gathered, the author remained present during all 40 interviews, resource assessments, and participatory mapping procedures.

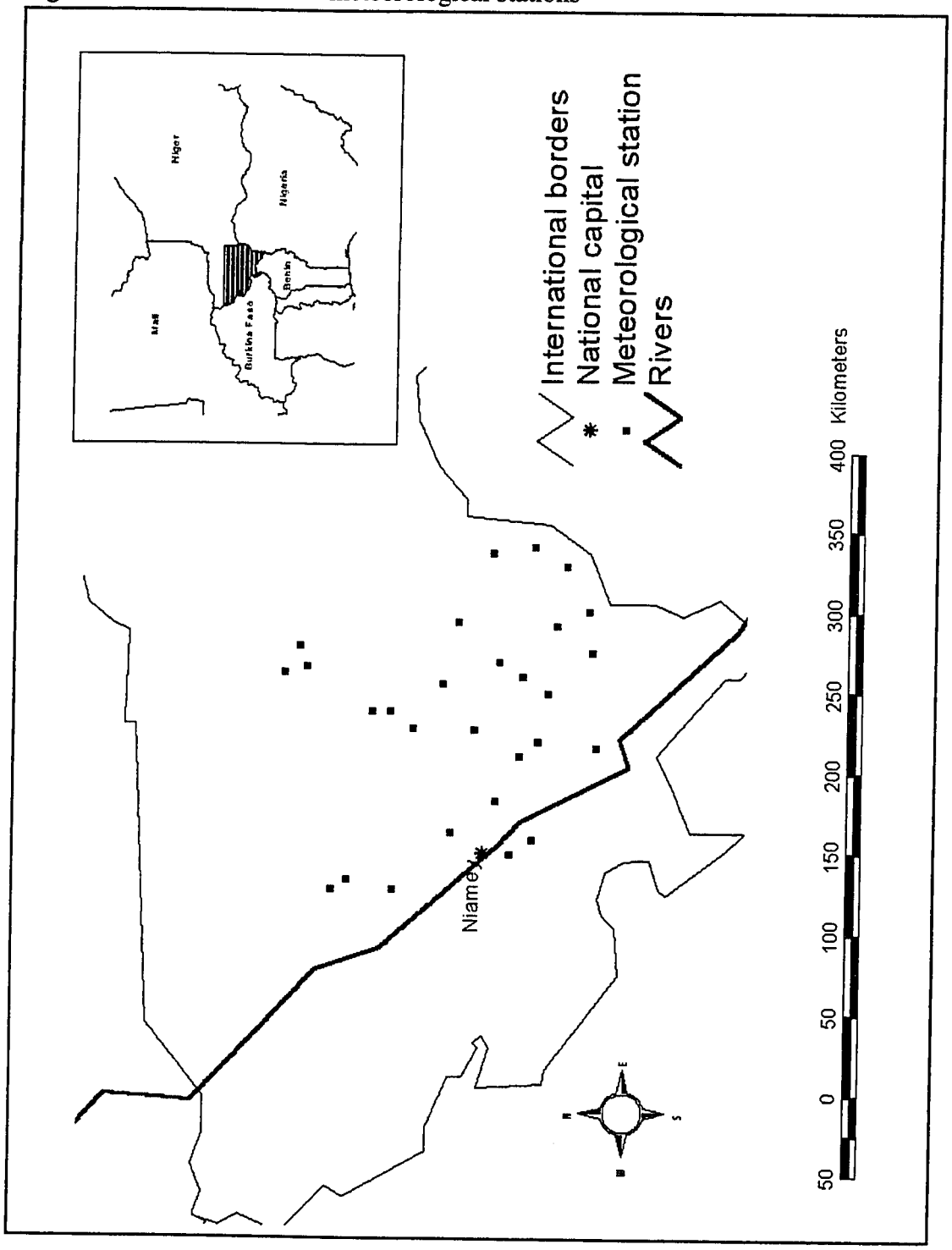
Sampling

A stratified sample (see the sampling procedure below) of 40 villages was selected. In order to minimize soil variations, all villages were chosen on the edge of the continental shield between 12°30' and 14°30' north and between 2°00' and 4°00' east. Villages were selected near meteorological stations for which rainfall data were available from 1990 to 1996. Seventeen meteorological stations in the survey area had all monthly data for the period considered, while eleven needed the interpolation of a minority of their monthly data. (See Table IV.1.) When necessary, monthly rainfall data were interpolated using the iterative polygon method as described in Morel (1992, pp. 22-23). A map showing the survey area is presented in Figure IV.1. For each meteorological station, all the villages within a five km radius from the station were identified. Within this sub-set of villages for which meteorological data were available, a stratified sample was constructed. The stratification criteria were average annual rainfall (R) and annual rainfall coefficient of variation (CoV). Ten villages were selected randomly within the four following strata: stratum 1, R below 520mm and CoV above 22.5 %; stratum 2, R above 520mm and CoV above 22.5 %; stratum 3, R above 520mm and CoV below 22.5 %; and stratum 4, R below 520mm and CoV below 22.5 %.

Table IV.1: Meteorological stations used and nearby one or several of the village surveyed.

	Longitude (°, North)	Latitude (°, East)	Average Rainfall (mm)	Rainfall Standard Deviation (mm)	Rainfall Coefficient of Variation (%)
Balleyara	13.77	2.97	458.9	64.9	14.1
Beylande	12.75	2.87	614.2	156.1	25.4
Birni N'Gaoure	13.08	2.9	518.6	100	19.3
Bolbol Goumande	12.97	3.55	638.4	136.6	21.4
Bonkoukou	14	3.07	475.1	122.8	25.8
Chikal Chinyasu	14.42	3.43	392.2	109.5	27.9
Damana	13.9	3.07	437.3	78.4	17.9
Dosso	13.02	3.18	586	161.7	27.6
Falouel	13.52	3.58	575	136.6	23.8
Fillingue	14.38	3.32	363	136.9	37.7
Goube	13.87	2.08	418	55.8	13.3
Guecheme	12.92	3.88	648.8	194.9	30
Hamdalaye	13.55	2.4	481.3	37.2	7.7
Harikanassou	13.18	2.83	500.3	88.1	17.6
Kara Kara	12.8	3.63	702.5	125.9	17.9
Kolo	13.3	2.35	533.5	96	18
Kore Mairoua	13.33	3.95	538	98.8	18.4
Koure	13.3	2.57	450	111.5	24.8
Loga	13.6	3.23	525.3	91.4	17.4
Moko	13.16	3.27	529.9	147	27.6
Ouallam	14.23	2.08	436.8	110.5	25.3
Sadore	13.23	2.28	552	122.2	22.1
Say	13.1	2.35	552.1	167.6	30.4
Simiri	14.13	2.13	340.5	85.3	25
Tessa	12.77	3.4	634.2	201.9	31.8
Tibiri	13.1	4	585.1	163.6	28
Toukounous	14.5	3.28	334.7	114.3	34.2
Yeni	13.43	2.98	556.5	133.8	24

Figure IV.1: Location of the meteorological stations



Participatory mapping

In each village, community-level interviews with key informants (village chiefs and their advisors) were conducted by the author accompanied by a translator. The participatory mapping consisted of the progressive drawing in the sand, by the community members, of the village land including the location of fields, pastures, water, areas of particular geographical interest etc. While the different elements of the map were identified, questions were raised regarding their use and eventually their management. The participatory mapping contributed to the building of a healthy relationship between investigators and subjects, as well as to a common understanding of the research theme and objectives. Sand diagrams were subsequently copied by the author on an A3 format paper.

Resource assessment

Following the participatory mapping exercise a precise determination of the village land boundaries and an assessment of the village's grazing resources was conducted with the village chief and/or his representative. The preparation of this field survey consisted of the preliminary identification of the different geographical units of the village land using a 1:50,000 base map. When the physical presence of the researcher on the village land boundaries was possible, their location was recorded (under digital format) using a

twelve-channel Global Positioning System. The boundaries were also recorded by drawing them on an overlay to the 1:50,000 map. When the physical presence of the researcher on the boundaries was not possible due to steep hills or ravines, the base map was used to interpret the information given by the village chief before drawing the borders on the overlay.

The resource assessment consisted of a survey conducted for each of the geographical units that were identified during the field survey preparation. For each geographical unit, the following information was geo-referenced and was visually estimated: proportion of fallow, bush, cultivated and barren land; millet density on cultivated fields; species composition (three dominant species) for the herbaceous layer and species composition for the tree layer (three dominant species); and level of grazing on the pastures. The maps were digitized, stored, and treated using a Geographic Information System (Atlas-GIS 2.0 for DOS and Arcview 3.2). (Sample Maps are given in Appendix 2.) For six villages for which satellite imagery was available, the mapping exercise in the fields was supplemented by a visual interpretation of satellite images (Spot multi spectral). This did allow a confirmation of on-field visual assessment of land use.

Gathering of socioeconomic data

Once the field survey was completed, group interviews were conducted to gather

socioeconomic data. In order to conduct these interviews, it was requested that the village chief organize a group meeting with his entourage, and with the villagers present at the same time. Questions were directed at the village chief who was the key interlocutor during the interview. The village chief would then consult with the group before answering. These groups ranged from 15 to 40+ participants, this number being mostly linked with the size of the village. Throughout the process the author was present, and the translator would translate the conversations occurring between the community members. While the translator wrote down the specific information on the questionnaire/data collection sheet, the author wrote down in his logbook any other information that would come out during the interview process.

These interviews had as an objective the gathering of data regarding village characteristics, agricultural production, livestock holdings, local institutions, interactions with authorities outside of the village, and property rights arrangements. The community surveys in their totality took 1.5 to 4 days per village. The duration of the stay in the villages had a major impact, namely, increasing the reliability of the data gathered. A second visit was conducted in order to gather supplementary data and to clarify issues arising from a preliminary treatment of the data from the first visit.

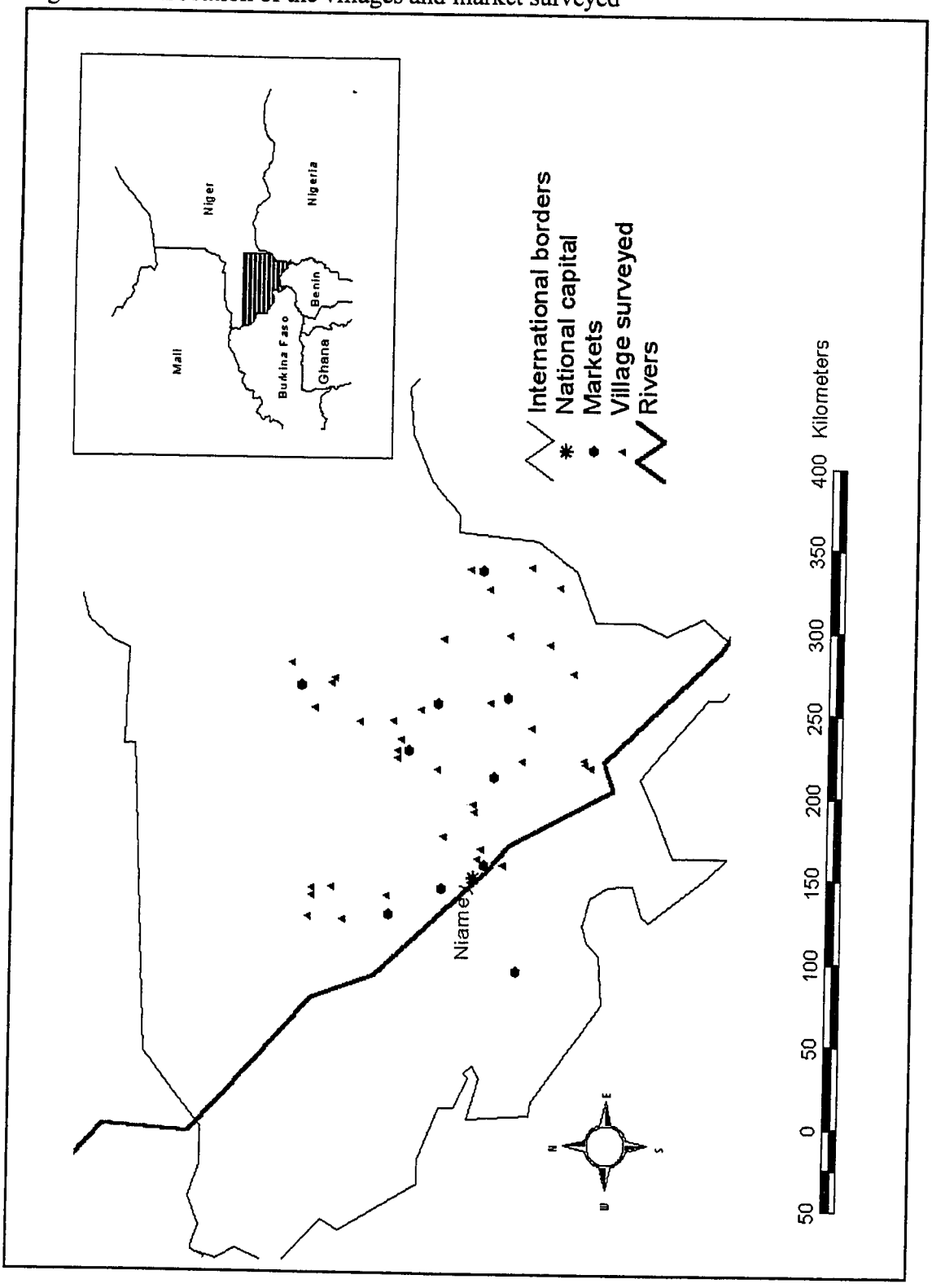
Livestock price survey

A separate livestock price survey was conducted in ten markets (see Figure IV.2) that were identified during the community surveys. Each market was visited six times during a twelve-week period. Small ruminants were weighed. Girth measurement was taken from cattle in order to estimate their live weight. The physical conditions of cattle were scored using the method explained in Nicholson and Butterworth (1986).

Millet production and prices

Data regarding millet prices were provided by the *Direction de la production vivrière, Ministère de l'agriculture* for the markets that were identified as millet markets by the communities that were surveyed. Millet is sold by the volume (the unit is a *tya* or small bowl) and production is estimated by the volume (the unit being a "bundle"); these units were weighed in each village (*tya* and bundle are different in different villages and markets) and market surveyed in order to compute production in terms of kg and price in terms of cfa francs per kilo.

Figure IV.2: Location of the villages and market surveyed



IV.2 Summary results from the community surveys

This section presents key observations made following the data collection. First, summary statistics are presented and discussed. Then observations regarding property rights, land use, livestock mobility, and conflicts are summarized.

Summary statisitics from the communities surveyed.

Tables IV.2 presents general statistics on the villages that were surveyed. The "youngest" village that was surveyed was founded approximately 40 years ago. This indicates that the sample groups villages that have existed since at least two human generations. It is, therefore, reasonable to consider that these villages form a relatively homogeneous sample in terms of land use and institutional stabilisation. The ages of the villages indicate as well that all the villages that were surveyed went through the environmental and socio-political changes that are described in Chapter III. The number of households in the villages that were surveyed is an important feature in the context of the analysis of collective action. (See Section II.4.) In terms of spatial organisation, higher numbers of households led to the existence of hamlets that are organized around wells. It must be noted, however, that the distance between hamlets rarely exceeds one kilometre. Household density is given here as a proxy for population density; the

Table IV.2: Summary statistics on the communities surveyed

	Mean	Standard deviation	Smallest value	Largest value
Village age (years)	217	167	40	700
Number of households	99	70	20	307
Number of ethnic groups	-	-	1	4
Household density (hh/km^2)	9.3	9.6	1.4	42.6
Percentage of households head leaving for dry season migration (%)	55	21	12	90
Distance from a regional market (km)	33	23	1	79
Number of meetings of the village chief with chiefs of neighbouring villages in 1996	24	28	0	104
Number of meetings of the village chief with the canton chief (traditional authority) in 1996	22	29	0	72
Number of meetings of the village chief with the prefect of his delegate (state authority) in 1996	7	12	0	52

average household size for southwest agro-pastoral Niger is 7.2 persons per household (UNDP 1997). The percentage of household heads leaving for dry season migration indicates two features that are of interest here. First, all villagers consider that dry season migration is the last recourse in order to gain a monetary income to compensate grain deficits. Dry season migration is, therefore, a proxy for the community's alimentary situation. Secondly, dry season migration has as a consequence that during an important part of the year (6 to 7 months) migrants are not able to communicate with other villagers

on issues of common concern (e.g., rangeland management). Villages across the sample were far from markets usually when they were far from major roads. The number of meeting with neighbours, traditional authority, and the state authority is presented to illustrate how the communities' integration within the larger political context may vary significantly.

Table IV.3 presents summary statistics in terms of land use and agricultural activities. Village land area varied widely across the sample. Larger villages (over 20 km^2) were, generally speaking, villages with more than 100 households and having a strong agricultural tradition. On the other hand, smaller villages in terms of area were villages

Table IV.3: Summary statistics on land use and agricultural activities in the communities surveyed

	Mean	Standard deviation	Smallest value	Largest value
Village land area (km^2)	17.8	11.5	1.2	40.33
Cultivated area in 1996 (km^2)	7	5.6	1.1	27.9
Cultivated area per household in 1996 (ha/hh)	8.3	5.8	1.3	23.9
Rangeland area in 1996 (km^2)	6.2	4.9	0.1	17.2
Land area in 1996 that is unsuitable for agriculture or pastures (sterile land) (km^2)	4.5	3.8	0	13.17
Proportion of land cultivated in 1996 (%)	43	19	14	90
Proportion of land in pastures in 1996 (%)	33	17	1	70
Proportion of sterile land in 1996 (%)	23	14	0	59

with a small number of households and, for the smallest, a strong pastoral tradition. Cultivated area consisted of areas where millet was sowed for the 1996 agricultural season. These areas varied significantly across the sample both in absolute and relative terms. Cultivated land consisted of land identified by the community members as the land having a potential for crop agriculture and the land that is sufficiently near to a water source for human consumption during the rainy season. Villages had different land endowments both in terms of quantity and in terms of quality. In the sample, there werefive villages with more than 40 percent of their total area unsuitable for either crop agriculture or rangeland. In the sample, there were four villages with ten percent or less of their area unsuitable for crop agriculture and rangeland.

Table IV.4 presents some key statistics on livestock raising activities and rangeland use. All communities had some level of livestock raising activities. A certain level of specialisation did occur in terms of cattle and sheep raising. Some villages would concentrate on cattle while others concentrated on sheep. This specialisation was mostly explained by villagers in terms of access to competent herders. Villages having access to Fulani herders concentrate on cattle, while villages having access to Bella herders concentrate on sheep. Goat raising is a marginal activity in the villages surveyed. A key issue for the purpose of the present research is the pressure on the range. In order to develop a single unit of mesure, cattle and small ruminants were converted into "tropical livestock unit" (TLU) (1 cattle equals 1 TLU, one sheep or on goat equals 0.2 TLU). The

average pressure on the range varied widely. Prices are given using the *Franc CFA*

Table IV.4: Summary statistics on livestock raising activities and rangeland users

	Mean	Standard deviation	Smallest value	Largest value
Proportion of households owning cattle (%)	55.9	31.9	0.1	100
Proportion of households owning small ruminants (%)	82.7	26.9	0	100
Average range rainy-season range pressure (TLU.day/km^2)	232	297	3	1336
Proportion of livestock going into rainy season transhumance (%)	32	34	0	98
Range quality index (theoretical min 0, theoretical max 5)	2.62	0.93	0.05	4.29
Beef meat price (FCFA per kg live)	318	31	225	384
Sheep meat price (FCFA per kg live)	467	111	353	703

(FCFA) (1 CDN $=400FCFA)

From these data, it is possible to describe the "average village" of the sample. Such a village was founded 217 years ago and groups 99 households living in one or two hamlets. The village chief meets twice monthly with other members of the traditional authority (chiefs of neighbouring villages, canton chiefs) and once every two months

with representatives of the state authority. Fifty-five percent of its household heads leave during the dry season in order to compensate grain shortages with a monetary income. These 99 households cultivate 7 km^2 in total and benefit from 6.2 km^2 of common rangeland. The quality of this rangeland is neither excellent nor poor. Outside of this quantitative information, other key observations were made in the course of the survey. These observations touch issues linked with property rights, land use, livestock mobility, and conflicts. They are presented below.

Property rights.

Regarding agricultural land, the pattern that is described earlier applied to all the villages that were surveyed. (See Table III.1.) Regarding rangeland, the situation was a bit more complex than the situation that is described in Table III.1. While access to rainy season and dry season pastures was considered open by all the communities surveyed, some of them managed to reduce this access through the enclosure of pastures with fields, or through the enclosure of watering points. It must be noted, however, that the informants of 25 villages reported that the pastures of the village were not used by neighbours during either the dry season or the rainy season. The only outsiders that were reported in these villages were transhumant herders during the early and late dry season. In the villages where rainy season pastures were actually used by neighbours, their contribution to the total range pressure rarely exceeded 10%. As for the exercise of a management right on

the pastures, no village reported such a practice. It is important to remember, however, that one of the most obvious management practices – the exclusion of outsiders – is not considered as proper behaviour and that it manifests itself rather informally (e.g., Turner 1998).

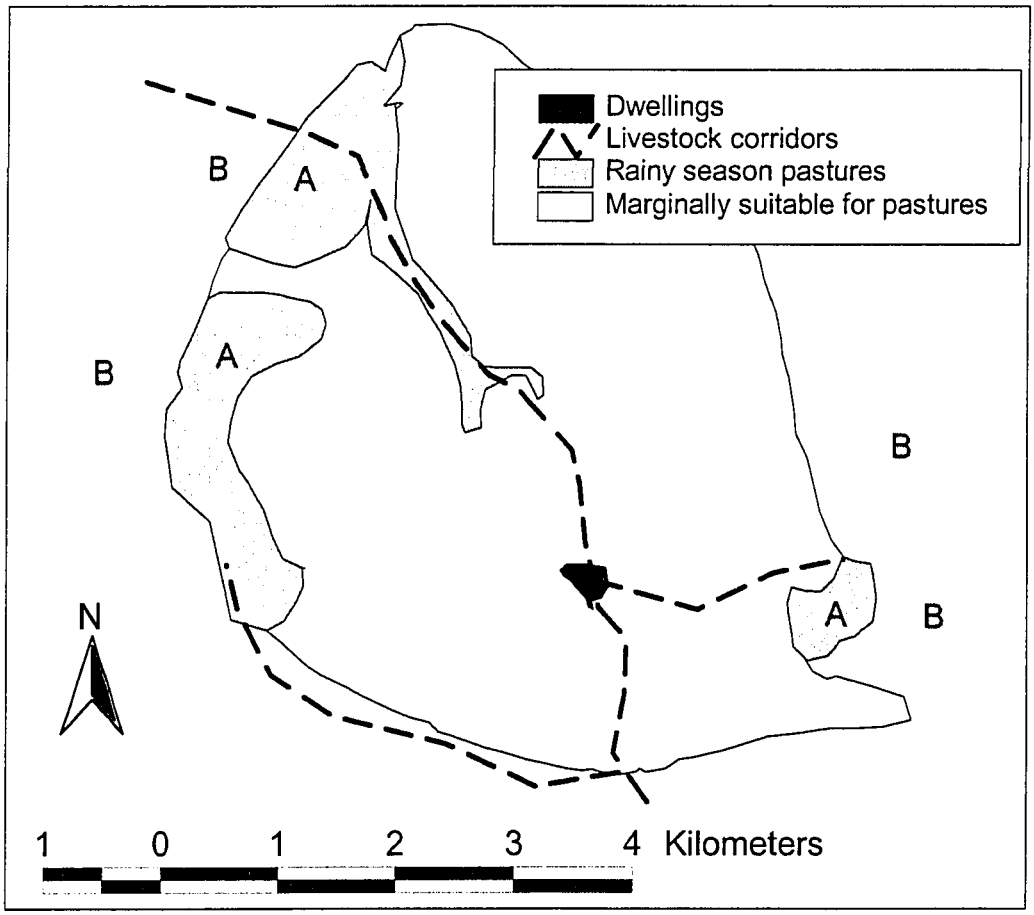
Land use

When considering land use, it is necessary to stress that in all interviews the priority, in terms of resource allocation, is millet production. This appeared through all of the formal and informal conversations that were held with villagers. Millet availability determines most decisions, such as dry season out-migration, the selling of livestock, and – of particular interest here – land use. Land allocated to pasture can be divided into two categories: fallows and land that was never cultivated. The decision to leave a field fallow stemmed either from a lack of field productivity or from a lack of manpower to cultivate the field. Land that never was cultivated is left uncultivated for two reasons. First, soil characteristics make it unsuitable for agriculture. Secondly, lack of water makes it impossible for humans to use the field for the duration of the agricultural season. The allocation of land to pastures stems, therefore, from a strong prioritization of agricultural activities.

Mobility

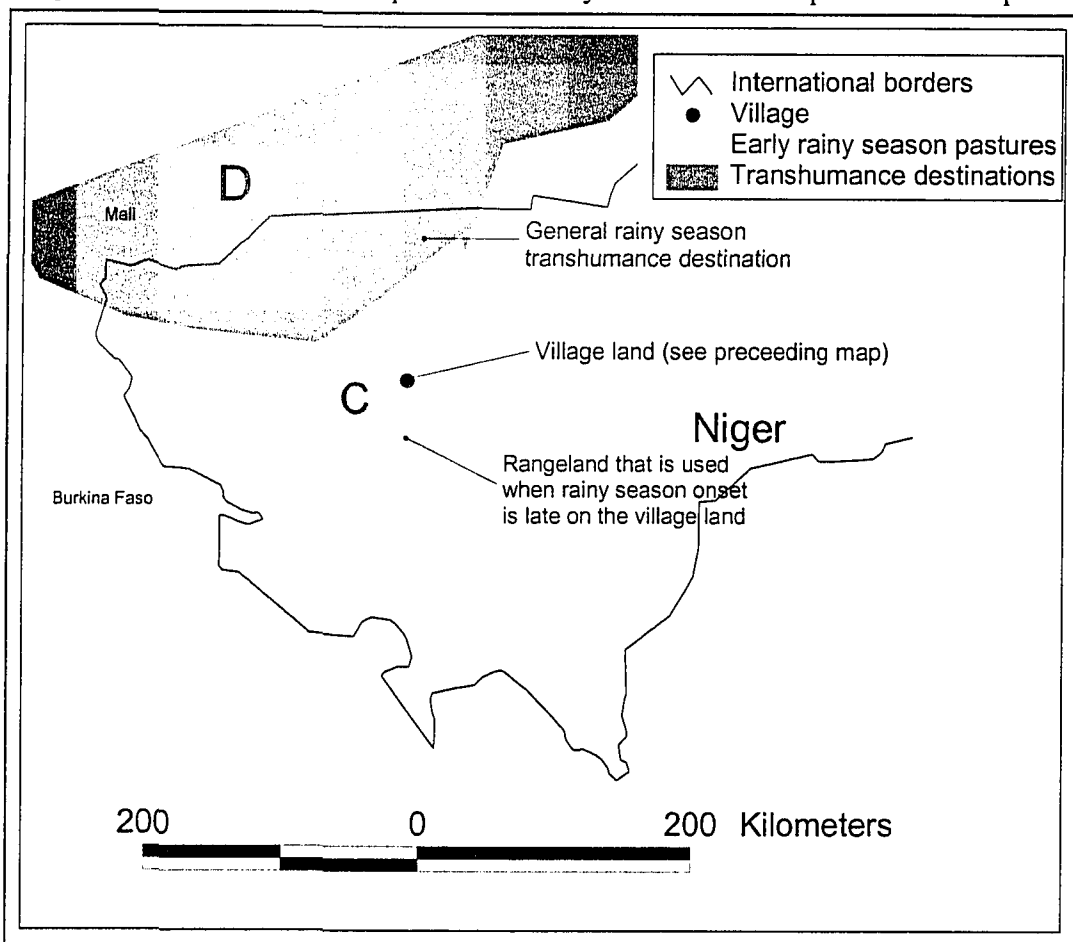
Of the 40 villages surveyed, a majority (25) had a part of their livestock away from their village land during some part of the rainy season. Using the observations made during the survey, one can schematically represent the pastoral action space of a community. (See Figure IV.3.) First, there is the village land corresponding to the French concept of *terroir foncier* (cf.Le Bris 1982, i.e., it is the action space on which the village has authority in terms of land tenure). The land encompassed in the *terroir foncier* is under the jurisdiction of the village chief. Decisions regarding land use are taken at the individual level (short-term fallow) and at the level of the village chief (long-term fallow). Nevertheless, these decisions are taken (see above) with a strong prioritization of agricultural activities. The quantity of rangeland available on the *terroir foncier* will, therefore, be the result of decisions at the household and community levels. Outside the village land, village members have access to any pastures of the "outside" world. This, of course, is at the cost of labour to keep the animals and at the cost of the sometimes increased risks of livestock losses through theft. In all villages where outside pastures were used, no formal relations of reciprocity could be identified. The use of the outside world can be characterized by the distance between the pastures that are used and the village. (See Figures IV.3 and IV.4)

Figure IV.3: Schematic description of the local rainy season pastoral action space.



Rainy season local rangeland use is characterized by different spatial units. The first unit consists of the village rangeland (A). These are areas where rangeland is predominant (rainy season pastures). During the rainy season, local livestock movement will occur between the dwellings and the pastures and between pastures. These movements are possible either because of livestock corridors or because of the existence of adjoining pastures. These areas are used by the livestock which are not leaving for transhumance. An alternative is the use of pastures on the land of nearby villages (B). Access to these pastures is not negotiated.

Figure IV.4: Schematic description of the rainy season non-local pastoral action space.



A first unit of non local rangelands consists of the rangelands that are 20 to 50 km from the village (C). These are used during the early rainy season/ late dry season when rain onset in the village is late. Access to these rangelands is sometimes negotiated (it used to be strictly negotiated).

A second unit of non local rangelands are the pastures reached during transhumance (D) (100-200km) for which there does not seem to be negotiation for access. While rainy season transhumance may involve the crossing of the border between Mali and Niger, this does not seem to be limiting rainy season transhumance.

These different units (local, regional or transhumance destinations) may be smoothly connected through fallows and pastures or, and this is more common, linked by a network of livestock corridors.

Daily movements to pastures shared with other villages in the direct vicinity occur generally during the rainy season. These pastures are often situated on plateaus bordering the village. These daily movements are justified by the need to have the animals graze in a place where they do not interfere with agricultural production. These pastures can be under the jurisdiction of a nearby village or under the jurisdiction of the *chef de canton* (district chief). No communities reported negotiating access to these pastures. Short-term (less than one month) movements, to pasture areas less than 50 kilometres away, occur generally (and not necessarily every year) towards the end of the dry season. When the rainy season starts early in areas less then 50 km away, livestock are sent to graze in these areas provided that the animals' health allows for these movement and provided that local resource scarcity (water and/or pastures) generates a need for these movements. Access to these pastures can be negotiated or not. In the sample, negotiations occurred in two instances where the destination area was under the jurisdiction of a traditional Fulani encampment area. Long-term (four months) transhumances during the rainy season, giving access to the outside world in its "totality," have as destinations pastures in northern Niger. The rationale given for these movements was two-fold. First, for agro-pastoralists with a strong agricultural tradition it was stressed that animals had to leave during the cultivation period. Second, most considered that rainy season pastures "up north" (i.e. transhumance destinations) were of much better quality. This transhumance destination, the *Azawak*, coresponds to the area north of the 300mm isohyet and is the same desitnation for all communities that

were surveyed.

The pastoral action space consists, therefore, of several sub-spatial units defined by the rationale for their use and tenurial status. The spatial sub-units can touch each other, allowing a passage from one to the other, or can be connected by transhumance corridors. What one must note also from the observations made above is that mobility has different justifications, each of which have characteristics that one has to keep in mind when modelling property rights, rainfall variability, and livestock development.

In the 15 communities where no livestock movement outside of village land were reported, the rationales given were the following: grazing resources on the village land are sufficient for the need of the livestock, and/or the expected cost of movement (i.e., livestock losses) was too high to justify movement, and/or the community does not have access to a competent herder to take care of the animals while away.

When considering the dry season, the pastoral action space changes. As the fields are open for crop residue grazing, they all become part of the pastoral action space. Nevertheless, the use of the dry season space is constrained by water availability. If water is available year round on or near the village land, livestock will normally be left grazing on and around the village land.

Conflicts

Resource-based conflicts, between herders and agriculturalists, are rather common occurrences in Western Niger. Table IV.5 summarizes the findings in terms of conflict of the survey conducted in the course of this research. Some of the major observations are: with one exception, no other resource-based conflicts, apart from farmer-herder conflicts, are reported; all resource-based conflicts between transhumant herders and agriculturalists, without exception, are settled locally; and the imposition of fines on transhumant herders does not seem to be a widespread practice.

Table IV.5.: Occurrence of land related conflicts during the agricultural season 1996-1997

	Conflict with transhumant herders	Other conflict linked with land tenure
Number of villages reporting these conflicts as common occurrence in 1996 (n=40)	24	2
Unsettled conflicts	0	2
Number of villages which did not fine the transhumant herders during the settlement of the conflicts (n=40)	15	-
Number of land tenure related conflicts where external help was needed for the settlement to go through	0	2

These observations seem to be contradicted by two following elements from other studies. First, pastoralists associations (i.e., associations lobbying for a greater political recognition of pastoral activities and pastoral ethnic groups) point to the fact that the imposition of unreasonable fines and the systematic settlement of conflict in favour of "agriculturalists" (i.e., Zarma or Haussa villagers) are growing practices (Magnant 1997). Secondly, Ngaido (1993a, 1993b) reports a growing number of range resources-based conflicts being brought in front of the Nigerien courts. Finally, resource-based conflict in Niger has already escalated up to the point where entire communities were destroyed. The most famous instance of these conflicts is the case of the village of Toda, where, in 1991, 104 lives were lost. These apparent contradictions need to be explored but are not directly relevant to this research.

IV.3 The structural model and the reduced form equations

The structural model that is used relies heavily on the structural developments of McCarthy (1998, forthcoming) and of McCarthy et al. (1998, 2001). The development of a model describing the situation of rangeland management decisions by groups under uncertainty has to capture a number of key characteristics: risk-averse behaviours, the role of livestock mobility, and the possibility that community-level collective action allows for the internal regulation (management) of use-rates or, in this specific case,

stocking rates on the pastures.

McCarthy (1998, forthcoming), proposes the structural model presented in Equation IV.1 (joint maximisation) and in Equation IV.2 (non-cooperative game structure). These equations and their mathematical development are explained in greater details in Appendix 6.

$$\max_{L1,L2} EU(\Pi^{JM}) = [PL_1 * f(L_1 + L_2;\beta) - cL_1 - \tfrac{1}{2}\sigma^2\phi_A(PL_1 * f(L_1 + L_2;\beta))^2] + [PL_2 * f(L_1 + L_2;\beta) - cL_2 - \tfrac{1}{2}\sigma^2\phi_A(PL_2 * f(L_1 + L_2;\beta))^2] \quad \textit{(IV.1)}$$

Where $EU(\Pi^{JM})$ is the expected utility under joint maximisation, P is the livestock price, $f(\ )$ is the average product function, input level of player i (i=1,2, here for the ease of presentation), β is a vector of technical coefficients, c is the constant marginal cost, σ^2 is the production variance, and ϕ_A is a coefficient of absolute risk aversion.

Equation IV.1 presents a simplified case where there are two herders. The two herders cooperate to maximize their joint utility (i.e., they manage their range perfectly). Their

joint utility is the sum of each herder's utility. Each herder's utility is a function of his[1] profit (product minus costs) and of his risk aversion and the degree of risk that he is facing.

Each herder's product is a function of the price (P) obtained for the product (i.e., meat), the quantity of inputs used (L_i) and the average product function ($f(L_1+L_2, \beta)$). The average product function gives the average quantity of output produced per unit of input and it is a function of the total number of inputs by all herders (i.e., the stocking rate) and is function of a vector of technical coefficients (i.e., rangeland quality, herders' ability). Each herder's cost is a function of the marginal cost of the input used (c) and the quantity of input that is used (L_i).

The utility derived from the product that is produced, given that producers are risk averse, is reduced by a factor linked with the output's variability. This factor is obtained through the mean variance approximation for expected utility (Hirschleifer and Reilly 1992, see Appendix 6) and by using a multiplicative specification for climatic variability (McCarthy 1998, forthcoming).

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[1]Herders in Niger are always men.

$$\max_{L1} EU(\Pi^{CN}) = [PL_1 * f(L_1 + L_2;\beta) - cL_1 - \tfrac{1}{2}\sigma^2\phi_A(PL_1 * f(L_1 + L_2;\beta))^2] \quad \textbf{(IV.2.a)}$$

$$\max_{L2} EU(\Pi^{CN}) = [PL_2 * f(L_1 + L_2;\beta) - cL_2 - \tfrac{1}{2}\sigma^2\phi_A(PL_2 * f(L_1 + L_2;\beta))^2] \quad \textbf{(IV.2.b)}$$

Where $EU(\Pi^{CN})$ is the expected utility under a Cournot-Nash (i.e., non cooperative) equilibrium.

Equation IV.2.a and IV.2.b describe similarly the situation where herders do not cooperate (prisoner dilemma game structure leading to a Cournot-Nash equilibrium solution). The major difference with equation IV.1 lies in the fact that each herder maximizes his/her individual utility, this with no regard for his/her impact on the other herder.

Through the development of this structural model and through the analysis of comparative statics, McCarthy (1998, forthcoming) demonstrates the following results. Risk-averse producers, facing a risky environment, will alway have a lower stocking rate under joint maximisation than in a non-cooperative game setting. Furthermore, McCarthy (1998, forthcoming) demonstrates that both risk-averse joint maximisers and risk-averse non-cooperators will decrease their stocking rate under increased risk.

Nevertheless, joint maximisation (i.e., perfect cooperation) and non-cooperative game settings are extremes. As argued in Chapter II, there is ample evidence that communities are able to manage their resources, at least partially. In order to address this issue of "partial cooperation," McCarthy et al. (2001) develop a model of costly cooperation, where the degree of cooperation reached is a function of the net gains of cooperation. It must be stressed here that cooperation may occur in several domains and that, as demonstrated by McCarthy et al. (1998), cooperation in one domain (e.g., social activities) may not necessarily lead to cooperation in another domain (e.g., range management). Nevertheless, cooperation in any domain is contingent on collective action, the determinants of which are presented in Section II.4. These determinants can be understood as the cost factors when assessing the net gains of cooperation. Following McCarthy et al.'s (2001) theoretical developments, the management of the range will, therefore, lead to a situation somewhere between non-cooperation and perfect cooperation.

To summarize these theoretical results, it is possible to write the following reduced form equation. This equation takes into account the results linked with equation IV.1 and IV.2, while simultaneously integrating a cooperation index that acts as a proxy to the cost of cooperation.

$$SR = F(\beta, c, \sigma^2, P, coop) \quad \textit{(IV.3)}$$

Where *SR* is the stocking rate and *coop* an index of cooperation.

Equation *IV.3* stated that the total number of animals will be a function of the state of the range (included in β), the herders' ability (included in β), the marginal cost of the input used (c), the output variance (σ^2), the output price (P), and the extent to which herders are able to cooperate.

When considering mobility, each livestock owner is faced with the decision of sending or not sending livestock in transhumance. The decision to send livestock in transhumance will be taken if the expected utility when sending livestock in transhumance is greater than the expected utility of keeping livestock on the village's range. Equation IV.4 presents the structure of this decision. If Bm is positive, livestock will be sent in transhumance. If Bm in negative or equal to 0, livestock will be kept on the village land.

$$Bm \equiv EU(\Pi^t) - EU(\Pi^h) = [PL_1 * f(\sum_i L_i^t; \beta^t) - c^t L_1 - \tfrac{1}{2}\sigma_t^2 \phi_A (PL_1 * f(\sum_i L_i^t; \beta))^2] - [PL_1 * f(\sum_i L_i^h; \beta^h) - c^h L_1 - \tfrac{1}{2}\sigma_h^2 \phi_A (PL_1 * f(\sum_i L_i^h; \beta))^2] \quad \textit{(IV.4)}$$

Where the super-(sub-)script "t" refers to variables while on transhumance and the super-(sub-) script "h" variables on the village home range.

Equation IV.4, following similar developments as in equations IV.1 and IV.2, is the difference between the expected utility (product minus cost, minus the risk aversion term) on the range at home, and the expected utility while on transhumance. It must be noted, however, that, as presented in Section IV.3, the destination for rainy season transhumance is similar for all the communities that were surveyed . This allows for the writing of the following reduced form equation:

$$Mob = f(SR^h, SR^t \beta^h, \beta^t, c^h, c^t, \sigma_h^2, \sigma_t^2, P) \quad \textit{(IV.5)}$$

Where *Mob* is mobility.

Equation IV.5 states that rainy season transhumance mobility for a specific community is a function of the stocking rate on the home range and on the transhumance range, of the range quality on the home rangeland and on the transhumance rangeland, of the herder's ability while on transhumance and at home, on the costs at home and on transhumance, on rainfall variance at home and on transhumance, and on meat prices. Nevertheless, as presented in Section IV.3, the transhumance destination is the same for all communities. The stocking rate, range quality, and rainfall variance while on transhumance are therefore similar across communities. Furthermore, all communities have a relatively good knowledge of their range resources. Therefore, herders' ability while on the home range may be considered as equivalent for all communities. Herders'

ability during transhumance may, on the other hand, vary significantly as a function of the village access to competent transhumant herders. Combining these results allows for the writing of the following system (more technical issues that are linked with this specification are dealt with in Appendix 6) of two equations as a reduced-form linearized model of the question at hand:

$$\begin{cases} SR^h = A_1 + B_1\beta^h + A_2 c^h + A_3\sigma_h^2 + A_4 P + A_5 coop + \varepsilon_1 \\ Mob = X_1 + X_2 SR^h + B_2\beta^h + X_3 c^t + X_4 c^h + X_5\sigma_h^2 + X_6 P + \varepsilon_2 \end{cases} \quad (IV.6)$$

The estimation of this system will allow the formal testing of the hypotheses stating that any single coefficient is equal to zero. If the results show that, for any of the coefficient this hypothesis can be rejected, then it will give an empirical indication that the variable associated with that coefficient is indeed a determinant of range use or mobility (an explicit list of the formalized hypotheses can be found in Appendix 6).

IV.4 Proxies, estimation procedure and results

Proxies and data

The rainy season stocking rate that is used is computed by averaging the stocking rate on the villages' pastures throughout the rainy season (RSSR) in order to obtain the pressure on the range. Mobility is computed as the proportion of villages' herds that leaves for transhumance during the rainy season (Mob). Monthly rainfall data was collected for the period 1990-1996[1], from 28 rainfall stations. From these records, average annual rainfall (RAIN) and a coefficient of variation of annual rainfall (RISK) are computed. The range quality for each of the geographical units identified on the village land is scored from 1 to 5. Range quality for each village is computed using the formula given in Equation IV.7, where i is a pasture score and A_i the proportion of the area available for pasture with the score equal to i (RQI).

$$RQ = \sum_i iA_i \quad (IV.7)$$

Where *i* is a specific range score and *Ai* is the village's proportion of rangeland having

[1]When choosing the time series that is used, data availability is a central issue. Since 1990, a greater number of meteorological station have been active in Niger. This explains the choice of 1990 as the starting year.

i as score. The score scale was developed by identifying first the level to which all species that were present in the herbaceous layer would contribute to livestock production. This was achieved through exchanges both with professional range ecologists and with herders. All the possibilities in terms herbaceous layer composition was then scored by combining the relative value of the species that were present.

The price per kilo live weight is computed using the results of the livestock market survey. This price is divided by local millet prices (Plm). Production costs are proxied using the distance from the nearest livestock market divided by local millet prices (Di). Millet price is chosen as the numeraire given the importance of millet consumption and its centrality in terms of decision making. For the stocking rate equation, herders' ability is considered as equal across the sample. This stems from the observation that all communities surveyed had at least one competent herder having a good knowledge of the local pastures. For the mobility equation the situation is different. Not all communities had access to transhumant herders. Herders' ability is, therefore, proxied by the proportion of traditional pastoralists living on the village land (PAST). The cost of mobility is linked with the decrease of meat production due to the distance covered while being on transhumance. This cost is proxied by the distance of the village from transhumance destination (DISTT).

Developing a proxy for cooperation, or as it turned out, of non-cooperation poses a

particular challenge. Considering that community members do meet and discuss the condition of the animals, the weather, and pasture, it can be argued that the extent of "cooperation" reached by a community will be a function of a number of variables that affect the ability of the community members themselves to appropriate any benefits associated with reduced stock densities (as opposed to non-members also gaining benefits), affect the capacity to negotiate and supervise members' actions, and affect the ability of members to reach mutually beneficial agreements amongst themselves. To capture these effects, it is possible to derive an index which includes the following variables: stock levels of neighbouring villagers using community pastures in the rainy season (RsIN) and in the dry season (DsIN), and dry season stock levels of transhumants (Transh), and the number of community members (TotHH), and the percent of households where the head of household migrated for work in the past year (MigW), and two indices of heterogeneity. The first is a very simple coefficient of variation measure of the cropland holdings (MilHet) (based on information on the smallest, largest, and average land size). The second is a measure of the ethnic heterogeneity in the community; there were between one and four ethnic groups in sample villages, and information was also gathered on the proportion of households in each category (EthHet). Ethnic heterogeneity may make informal cooperation based largely on norms more difficult, whereas large differences in wealth reduce the range over which common agreements can be formed. In order to develop this index a principal component factor analysis was conducted. Results of a factor analysis – using principal component factors

(Dillon and Goldstein [1984]) – are presented in Table IV.6 for the first two principal factors. The third factor had an eigenvalue less than one and was not retained in order to keep the number of independent variables low. These factors are used to build two non-cooperation indices, NC1 and NC2. The reason for using principal component analysis is two-fold. First, it reduces, through the use of only two factors, the number of independent variables. Secondly, it suppresses endogeneity problems (i.e., estimation problems linked with the existence of correlation between independent variables).

The first factor has relatively high and positive coefficients on intra-community variables thought to make informal cooperation more difficult – total households, migration, and cropland and ethnic heterogeneity. Rainy season in-migration also has a relatively large positive coefficient, whereas dry season in-migration and transhumant herders have negative, though low, coefficients. This variable captures intra-community factors making cooperation more difficult. The second factor has high coefficients on both dry and rainy season in-migration, and low but positive coefficient for transhumance. Total households and cropland heterogeneity are also positive, but migration is negative but with relatively low coefficients. This factor is more difficult to interpret because it captures the impact of both external and internal effects making cooperation more difficult.

Table IV.6: Results of principal-factor component analysis for the determinants of cooperation (two factors retained)

		Factor 1	Factor 2
Eigenvalue		1.774	1.646
Cummulative		0.2534	0.488
Scoring coefficient for:	DsIN	-0.03545	0.43571
	RsIN	0.3714	0.35252
	TransH	-0.05184	0.08495
	TotalHH	0.23779	0.19954
	AvgMig	0.25295	-0.13084
	MilHet	0.43172	0.16073
	EthnHet	0.23489	-0.09125

Estimation procedure and results

Using the data set that is described above, the system presented (Equation IV.6) is estimated using a two-stage least-square procedure (Johnson et al. 1987) with robust variance obtained following the method developed by Huber (1967) and White (1980, 1982). The estimation procedure was conducted using the Stata 6.0 statistical package software (Stata Corporation 1999). The results of the estimation procedure are presented in Table IV.8 and are discussed in the following section.

IV.5 Discussion

When considering the small number of degrees of freedom (29) as well as the complexity of the modelling exercise, the stocking rate equation (the first equation of the system presented as Equation IV.6) performs well (r^2=0.5056). Only four coefficients are significantly different from zero. The two first coefficients are the non-cooperation indices NC1 and NC2 (which are indices of non-cooperation) which are positive. These results indicate that the stocking rate on communities' rangeland is a function of the potential of communities for cooperative behaviours. Rangeland in southwest agro-pastoral Niger is therefore managed, provided that the communities' characteristics allow for cooperation to occur. The third coefficient that is significantly different from 0 is therelative price of livestock; it is positive. This means that community members will increase the number of animals on the rangeland when livestock prices increase which is consistent with the model that is developed. The last coefficient being significantly different from zero is the constant. The fact that it is positive seems to indicate that regardless of livestock prices and level of non-cooperation (i.e., if these variables equal zero), there will alway be livestock on the range. This may be an indication that one or several variables are omitted (i.e., if livestock prices are equal to zero, il is unlikely in the model that is presented that the stocking rate will be positive). A possible omission is the value of livestock for non-market purpose (manure production, symbolic value). This

Table IV.7: Econometric results

	Stocking rate equation		Mobility equation	
	coeff	t-stat	coeff	t-stat
RQI (range quality index)	102.2039	1.511	0.641713	1.122
Di (distance from market)	314.1929	0.893	0.343194	0.606
RISK (rainfall coefficient of variation)	-819.9082	-1.379	-0.4880999	-0.517
Plm (price of livestock)	176.0657*	-2.551	0.3324881*	2.964
NC1 (non-cooperation index 1)	-153.7919*	-2.062	-	-
NC2 (non-cooperation index 2)	-155.0457*	-2.116	-	-
SRRS (rainy season pressure on the range)	-	-	0.000184	0.8
PAST (proportion of pastoralists)	-	-	0.3388992*	2.064
DISTT (distance to transhumance territories)	-	-	11.95619	0.565
Constant	794.2912*	2.357	-1.531822	-1.029
R^2	0.5056		0.3643	
Prob > F	0.0307		0.0009	
N	36		36	

*Indicates the coefficient that are significantly different from 0 (α=5%)

seems to point to potential limitations of the model that are discussed below.

When considering the mobility equation (i.e., the second equation of the system presented in Equation IV.6), its performance may be considered as satisfactory (r^2=0.3643) considering, again, the small number of degrees of freedom (28) and the complexity of the dynamic that is modelled. Two coefficients are significantly different from zero. The first variable that has a coefficient significantly different from 0 is the proportion of traditional pastoralists living on the village land. This suggests that the key to livestock mobility is the degree of pastoral tradition. This is of paramount importance considering that most agro-pastoralists do not have a strong pastoral tradition. When considering the hypothesis regarding mobility as a risk management strategy, the results show rainfall variability does not impact mobility. This could indicate that (1) livestock mobility is not a risk management strategy, or – and this is more likely – (2) that the constraint on mobility is the availability of competent herders and that this constraint is sufficiently important to render this result inconclusive.

The second coefficient that is significantly different from 0 is the price of livestock. This result is similar with the result of the stocking rate equation.

While results coming from the econometric modelling exercise point to some key conclusions of the present dissertation, it must be noted that this approach is not without

shortcomings. First, the specification of the structural models is directly linked with the assumption that the livestock raisers' utility is derived from their revenue. While the use of millet as numeraire is consistent with the fact that the agro-pastoral economy of southwest Niger is a subsistence economy, this approach does not allow for non-market values to be taken into account. Secondly, the quantitative data requirement for such a model is quite heavy. For instance, data on revenue and livestock holdings may be considered as private issues by agro-pastoralists. Nevertheless data collection was conducted at the community level, thus shielding individuals from having to reveal their individual characteristics. Furthermore, the dataset represents a "snapshot" of the situation with very little historical contextualization. Thirdly, for several variables (costs mostly), these issues with data are compounded by the fact that the dataset allows only for the use of proxies. These proxies, while capturing the "essence" of the variables, are only approximations. These shortcomings, while important, do not prevent the modelling exercise from yielding results. Nevertheless, extreme care must be taken when trying to draw conclusions from econometrics only. It is important to keep in mind that econometrics is only a part of the present dissertation and that without the approaches and results presented in Chapters V and VI, econometrics may seem a quite weak approach to describe the issues at hand in their totality and complexity.

From the econometric analysis, two major conclusions can be presented: community level management in southwest agro-pastoral Niger is a definite possibility, and agro-

pastoralists are directly dependent upon traditional pastoralists when livestock has to be sent in transhumance. From the information presented in Section IV.3, it is possible to infer that livestock mobility is important for agro-pastoral communities. The results of the econometric modelling seem to indicate that the major problem for sending livestock in transhumance is the availability of traditional pastoralists as a specialized labour force. The focus of the next two chapters will, therefore, be on the possibility of sustained interactions between agro-pastoralists and transhumant herders.

CHAPTER V: ANALYSING THE CLOSURE OF THE PASTORAL SPACE IN SOUTHWEST NIGER: AN HISTORICAL EVENTS ANALYSIS

A first result of Chapter IV is that range management is a definite possibility when local cooperative dynamics are strong. Secondly, Chapter IV shows that livestock mobility is perceived by agro-pastoralists as a key management tool as well as a mechanism by which access to high quality pastures is obtained. Finally, Chapter IV shows that agro-pastoral communities are extremely dependant on transhumant herders in order to allow their livestock to be mobile. Despite the centrality of livestock mobility for agro-pastoral communities, there is evidence, however, that the pastoral space (i.e, grazing areas and migration corridors) in southwest agro-pastoral Niger is increasingly closed (i.e., it does not allow for livestock mobility during the rainy season) (Colin de Verdière 1995). The closure of the pastoral space may take several forms. Transhumance corridors may be cultivated, access to watering points may be curtailed, access to local pastures may be restricted by enclosing these pastures with fields. All these actions, which restrict livestock mobility, may be responsible of pastoral space closure.

This closure has a direct and an indirect negative impact on livestock mobility. The direct impact is linked with the fact that the closure of the pastoral space may seriously hinder livestock mobility. The indirect impact is that interactions between transhumant

herders and agro-pastoralists may be both decreasing and growing more conflictual. The complementarity of these two production systems highlighted in Chapter IV may, therefore, lose all opportunity to contribute to agro-pastoral development to its full potential.

The present chapter is an attempt at analysing how the closure of the pastoral space is occurring through time. The goal for developing this understanding is to assess whether the closure of the pastoral space may be avoided and/or reversed. The chapter is divided into five sub-sections. The first section describes the analytical framework that was chosen. The second section presents the four villages where this analysis was conducted. The third presents the data collection method while the fourth and fifth contain the results and their discussion.

V.1 Analytical framework

The closure of the pastoral space in southwest agro-pastoral Niger represents a shift in tenure institutions. Because institutional changes are pathway-dependent (i.e., institutional change is dependant upon the local history) (Bergeron and Pender 1999, North 1990, Pender et al.1996, Vayda and Walters 1999, Walters et al. 1999), the analytical framework that is used here relies heavily on the analysis of local historical

events. In order to build a local event history, endogenous events are distinguished from exogenous events. Endogenous events are events that originate locally, while exogenous events originate outside of the local community's control sphere. Furthermore, ecological events (i.e., events linked with changes in the environment composed of ecological factors such as drought) are distinguished from social events (i.e., events linked with changes in the social and economic environments such as national political changes, change of village chief). This distinction allows for a clearer identification of an eventual relationship between events on which communities have a certain level of control and events that are beyond their control.

As discussed in Chapter II, analysing the closure of open access or common property resources leads to fairly different conclusions depending on the theoretical framework that is used. It is, therefore, of paramount importance when analysing such a dynamic to try to avoid being (mis-)led by conceptual or theoretical preconceptions. Event analysis is an approach that allows the analysis of natural resource management outside of the strict boundaries originating from an *a priori* theoretical framework. This approach, similar to the approach used by Vayda and Walters (1999) and by Walters et al. (1999), has the definite advantage of allowing the analysis of a research question while minimizing any conceptual errors that could stem from ideological biases (Vayda and Walters 1999). When the event chronology is established, the challenge lies in linking the observations with existing theoretical frameworks.

In order to facilitate the analysis of the closure dynamics, this approach can be refined by analysing communities with similar environmental features (such as soils or local climate) while having differences in terms of institutions (such as different property rights on rangeland). Identifying linkages between the similarity and differences in events allows a better identification of the determinants of institutional change.

V.2 Villages studied

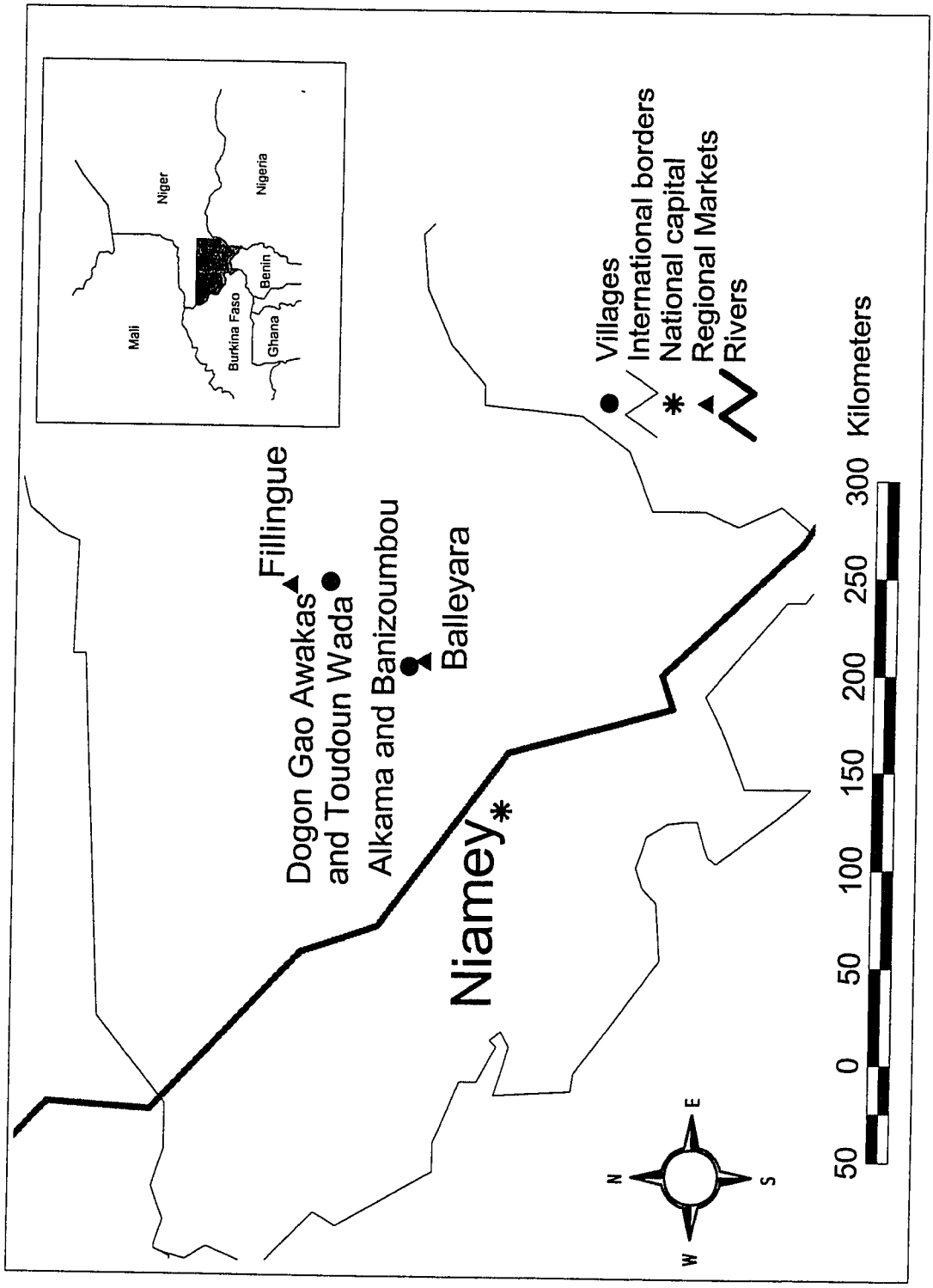
Four villages were chosen in which to conduct the research linked with the present chapter. The selection of these villages was undertaken using the results of the survey conducted in 40 villages for the fieldwork linked with the research presented in Chapter IV. The four villages consisted of two pairs. Each pair was chosen in order to have villages sharing the same climatic environment while having different levels of pastoral space closure.

The first pair of villages consisted of Alkama (13.82°N, 2.97°E) and Banizoumbou (13.83°N, 2.93°E). (See Figure V.1.) While sharing a common border and the same climatic environment, these two villages were different in the following ways. Banizoumbou villagers have recently enclosed a traditionally open access resource: water. Moreover, transhumance corridors in Banizoumbou have been recently converted

into cultivated land. The combination of these two features – access limitation to water and disappearance of tranhumance corridors – led to a relative privatization (as village commons) of Banizoumbou pastures. The consequence of this privatization is that the pastoral space in Banizoumbou has been closed. In Alkama, while some water points are enclosed by dry season cultivation, most water points are still readily accessible. Transhumance corridors in Alkama are not cultivated. Another key difference between Alkama and Banizoumbou lies in the availability of water. Banizoumbou has only two watering points, relatively small temporary ponds. The water table is deep. In Alkama, there are no ponds, but the water table is near the surface level; water is, therefore, easily accessible throughout the village land.

The second pair of villages consisted of Dogon Gao Awakas (14.23°N, 3.34°E) and Toudoun Wada (14.19°N, 3.37°E). (See Figure V.1.) These two villages, while sharing a common border and having the same climate, differ in their level of range enclosure. In Toudoun Wada, the only transhumance corridors border the village. None cross the village land. The only livestock watering point is enclosed. In Toudoun Wada, fallow land, that is used as rangeland during the rainy season, is not readily accessible. Amongst the 40 villages surveyed in southwest Niger, Toudoun Wada is the only village where access to rainy season fallows was somehow regulated. One cannot, in Toudoun Wada, lead livestock to a fallow without asking permission of the agricultural use right holder. In Dogon Gao Awakas, on the other hand, transhumance corridors do cross the

Figure V.1: Map showing the location of Alkama and Banizoumbou, and of Dogon Gao Awakas and Toudoun Wada



village land; rainy season fallows and water points are accessible through a network of livestock corridors. Water availability differs in both villages. Toudoun Wada has a single temporary pond, while Dogon Gao Awakas has two large semi-temporary ponds.

It must be noted that Banizoumbou and Toudoun Wada are, among the 40 villages surveyed in the course of the fieldwork linked with Chapter IV, the two villages where the closure of the pastoral space appears to be the most important.

Table V.1: Key charateristics for Alkama, Banizoumbou, Dogon Gao Awakas, and Toudoun Wada	Banizoumbou	Alkama	Dogon Gao Awakas	Toudoun Wada
Ethnic majority	Bella	Bella	Bella	Djerma
Total number of households	137	236	120	90
Distance to a regional market	9 km	9 km	19 km	19 km
Total area	24 km^2	8,5 km^2	5 km^2	3 km^2
Rangeland area	15,5 km^2	3,6 km^2	1 km^2	0,5 km^2
Average rainfall (1990-1996)	460 mm	460 mm	392 mm	392 mm
Rainfall standard deviation (1990-1996)	65 mm	65 mm	110 mm	110 mm

Banizoumbou and Alkama are two Bella villages, their land area is quite large, and the spatial organisation of households is the following: household dwellings are in the fields and fairly distant from each other. These two villages are adjacent to the regional market of Baleyara and most villagers visit the market at least once a week. The principal activity for both villages is millet cultivation for consumption. The average annual rainfall for both villages is well above the necessary minimum for millet cultivation. Rainfall variability is moderate and, with the exception of drought years, these villages are not normally confronted with serious grain deficits. (See Table VI.1 for key statistics.) Dogon Gao Awakas is a Bella village and Toudoun Wada is a Djerma village. While this difference is important in terms of ethnic origin and cultural tradition (i.e., Djerma are traditional crop agriculturalists, while Bella are former slaves of the Twaregs and have a strong pastoral tradition), most community members agree that, since the sedentarization of Dogon Gao Awakas' population, most differences in terms of agricultural production strategy and village organization have been reduced.

Dogon Gao Awakas and Toudoun Wada are relatively small villages. The spatial organisation of both villages is similar: household dwellings are grouped in one hamlet. They are both far from the nearest regional market and most villagers will not go to the regional market more than a few times per year. Millet cultivation is the principal activity for both villages. While the average annual rainfall is sufficient for millet cultivation, rainfall variability is sufficiently important to generate a permanent risk of

grain shortages in both villages.

V.3 Method

In order to build the local-event chronology, three complementary approaches were used: focus groups; household-level semi-structured interviews; and a land-use history constructed through semi-structured interviews with key informants and village land surveys. The fieldwork was conducted between August and November 1998. The survey tools are presented in Appendix 3.

The translators, while being familiar with household level and group interviews, had never before conducted focus group research. Before carrying out this aspect of the research in the villages, the translators were trained in conducting a focus group. This training consisted of reading and discussing Geoffrion (1997). Following this, the translators were asked to identify the major characteristics of focus group research with which they were least familiar. Following discussion of these characteristics, a list of "Dos and Don'ts" was established. Finally, one bogus focus group (grouping friends and colleagues) was conducted by each translator in the presence of the author, followed by extensive debriefing.

In each village, four focus groups (Geoffrion 1997, Krueger 1994, Morgan 1997) were conducted, with each focus group meeting twice. These focus groups were stratified by age (over 30 and below 30) and by gender, and included 6 to 10 participants. The theme of these focus groups was identified to the participants as "the village history's most important events." Each moderator had an interview guide comprising a topic guide in order to ensure consistency and comparability between the different strata and villages. Two focus groups in each village were conducted by the author accompanied by a translator. The other focus groups were conducted by the translator of the first two focus groups. The goal of these focus groups was to begin the identification of the village's event chronology. The results of a preliminary analysis of these focus groups were used to define an interview framework for semi-structured household level interviews (Savoie-Zajc 1997). The interview framework was pre-tested by author accompanied by a translator/interviewer.

These semi-structured interviews were conducted with 20 heads of households – all men, female household heads being extremely rare – in each village. The interviewees were selected randomly from a list of all households. This list was obtained through administrative authorities (i.e., *Sous-préfecture* or *Préfecture*) and brought up to date in the course of the research. Five interviews in each village were conducted by the translator under the supervision of the author. The translator conducted the remaining interviews. The purpose of these interviews was to allow a household level

contextualisation of the results of the focus groups. They also allowed a minimization of potential small group dynamic biases stemming from the focus groups (i.e., because of the structured hierarchical organization in the villages, there was a definite risk that a minority might control the focus groups).

The interview guide had two sections. The first section dealt with questions regarding the household's particulars, agricultural practices, and livestock management practices. The second part dealt with five questions on the following themes: land-holding history, livestock ownership history, local rangeland history, land availability history, and village life history. Detailed maps for the four villages are presented in Appendix 4.

Finally, the village land was surveyed with key informants in order to identify changes in land use that affected rangeland use in the past. A first step was built on the results of the participatory surveys conducted in the course of the field work linked with Chapter IV. The emphasis was on past and present watering points, transhumance corridors, and pastures. Following this survey, the history of individual fields cultivated in the vicinity or on the features identified was established with its current and/or past user. This part of the fieldwork was conducted by the author accompanied by a translator.

V.4 Results

Alkama

Since its founding in the early 1890s, Alkama has gone through several key changes. (See Table V.2.) First, between the late 1890s and the late 1920s, Alkama went through its "golden years." These years were characterized by high and diversified agricultural production (millet, cowpea, rice, cotton, cassava) and high livestock holdings and milk production. Most families owned horses. Since the early 1930s, following Alkama's first-reported drought, named Ban' Kanai, the quality of life in Alkama has never gone back to these years. Three causal factors are given to explain why Alkama villagers' wealth was never rebuilt to pre-Ban' Kanai levels. The first causal factor is an increase in the occurrence of drought; this is the reason most often given in the focus groups and in the household level interviews. The second is the decrease of available land attributed to an increase in population. Finally, pasture availability decreased following the harvesting of pasture forage in order to sell it to outsiders. This practice began just after Alkama's second reported drought, Garojire (in the late 1960s) and became widespread following Alkama's third reported drought, Albanajire (1973-1974). This last event is quite important for the purpose of the present research. Alkama was chosen because of an apparent lack of rangeland privatization. While rangeland in Alkama is not privatized

in terms of control of the access right to the range resource, the withdrawal and appropriation of the range resource leads to the same outcome, namely, exclusion of outsiders from the resource. It must be stressed, however, that range resource harvesting occurs mostly during the early to mid dry season which is the period when fallow and fields are open to everyone (see Table III.1)

Droughts occupy an important place in Alkama's history. After the three first droughts, two subsequent droughts were reported: Karamrami (1984) and Tarsassajire (1998). This succession of five droughts is reported as having the effect that, since 1974, livestock holdings and grain stocks are constantly under the risk of disappearing. It must be noted that, since the Albanajire drought (1973-74), drought years are used by Alkama's villagers as reference years to identify other years (e.g., 1975 is named Albanajire plus one year, 1987 is named Karamrami plus three years). This shows that droughts are important locally in the structuring of history. Finally, while droughts do play a central role in Alkama's chronology, Table V.2 shows that other events are also important (e.g., reign of a particular village chief) and that Alkama's population is well abreast with changes in the larger political environment (e.g., national political changes).

In terms of land use and tenure, two major changes are reported. First, in the mid 1980s, a redefinition of larger administrative boundaries (i.e., cantons) led to a net loss of

Table V.2: Event chronology for Alkama

	Event reported by the community members
early 1890s	Founding of Alkama
early 1890s to late 1920s	Alkama's golden years, succession of Dabo (2nd name unknown, date not identifiable), Agali Etekey (date not identifiable), and Adoum Baba (1909), as village chiefs.
early 1930s	Ban' Kanai drought
1939	Alhattab Baba becomes the village chief
1942	Seidi Djibril becomes the village chief
1943	Agali Mahamad becomes the village chief
1957-59	End of forced labour, referendum on independence, the burning of silos is attributed to Djibo Bakari, demise of Djibo Bakari
1960	Diori Hamani becomes Niger's first elected president
1966	Garojire drought, begining of the harvesting of forage
1973-74	Albanajire drought, increase in the harvesting of forage, Soli Alhattab becomes the village chief
1974	Seyni Kountche becomes Niger's second president following a military coup
1984	Karamrami drought, Goubour Soli becomes the village chief
1986	Changes in Canton boundaries leading to a net loss for Alkama
1987	Death of Seiny Kountche, Ali Saibou becomes president
late 1980s	Digging of two wells for dry season cultivation
1990	Introduction of multi-party democracy
1991	National Conference, Cheffou Hamadou becomes prime minister
1993	Mamane Ousmane becomes president
1996	Bare Mainassara becomes Niger's president following a mititary coup. Elections confirm his presidency
1998	Tarsassajire drought

Alkama's village land. This land fell out of the power of Alkama's chief and is now cultivated by members of another community. Secondly, in the late 1980s, two wells were dug by an aid agency project in order to allow for dry season vegetable cultivation. This area has been enclosed and is not accessible to livestock anymore. Nevertheless, Alkama's pastoral space remains open, even if, as noted above, the resource is appropriated during the dry season. When analysing the history of the fields bordering the transhumance corridors, it appears that the delimitation of these fields has not changed in recent history. Alkama remains, therefore, a village where transhumant herders are able to pass through while not being able to spend time feeding their cattle on the village land once the forage is harvested.

Banizoumbou

Table V.3 presents the event chronology for Banizoumbou. The Banizoumbou foundation date remains unclear. Foundation years that were traced through the focus groups range from the tenth century to the mid-seventeenth century. The most ancient event that can be dated is the beginning of the reign of a village chief named Hama Abderrahman in the mid-1890s, which corresponds to the period when the village location was stabilized. Banizoumbou may, therefore, be considered as an ancient village.

Table V.3: Event chronology for Banizoumbou

	Event reported by the community members
1000-1750	Founding of Banizoumbou
1895	Hama Abderrahman becomes the village chief
1896	Boukarin Hama becomes the village chief
1903	Ichaq Aboukarin becomes the village chief
1918	Moussa Aboukarin becomes the village chief
1936	Alassane Moussa becomes the village chief
1950	Issalek Alassan becomes the village chief
1957-59	End of forced labour
1960	Diori Hamani becomes Niger's first elected president
1968	Creation of the *poste administratif* in Balleyara
1973-74	Kilo drought
1974	Seyni Kountche becomes Niger's second president following a military coup
1974-75	Enclosure of ponds, cultivation of transhumance corridors
1984	Karamrami drought, major fire in the village's fields
1985	Begining of the harvesting of forage
1986	Changes in Cantons boundaries leading to a net loss for Banizoumbou
1987	Death of Seiny Kountche, Ali Saibou becomes president, Banizoumbou is attached to the Fillingue *département*
1990	Introduction of multiparty democracy, minor drought (un-named)
1991	National Conference, Cheffou Hamadou becomes prime minister
1993	Mamane Ousmane becomes president
1996	Bare Mainassara becomes Niger's president following a mititary coup. Elections confirm his presidency
1998	Maygaassi drought

Banizoumbou went through two periods that are characterised by its population as "golden years." A first period spanned the years between the village foundation and Banizoumbou's first-reported drought, named Kilo (1973-74). These years are characterized as plentiful in terms of agricultural production and livestock holdings. A second period spanned the time between Banizoumbou's second reported drought in 1984 and 1990. These years are characterised by plentiful agricultural production. Herd re-construction was, however, not possible in Banizoumbou during this fairly short time span. In 1990, a minor drought hit Banizoumbou again and, since then, the years are characterized as "difficult." Another drought, named Gandey Kazeri, occured in 1998. Again, as in Alkama, drought and population pressure, are identified, in that order, as the causal factors for the decrease of the quality of life in Banizoumbou. As in Alkama, recent years are identified by using drought years as reference years.

In terms of land use, three major events are reported. First, in the mid 1980s, a re-definition of larger administrative boundaries (canton) led to a net loss of Banizoumbou's village land. This is the same event that led the loss reported in Alkama. Secondly, land use went through two other major changes in Banizoumbou. The cultivation of all the land encompassing the major watering points was implemented and Banizoumbou's largest transhumance corridor was turned into cultivated fields. These two events complement each other, resulting in a closure of Banizoumbou's pastoral space. The analysis of the history of the fields encompassing the watering points and of

the history of the fields occupying the former transhumance corridor shows that their cultivation was implemented in the two years following the Kilo drought. Thirdly, in terms of rangeland, the years following the Karamrami drought saw the beginning of the systematic harvesting of forage on the rangeland.

Dogon Gao Awakas

The founding of Dogon Gao Awakas is reported to have occurred 20 years before the arrival of the French colonization. Originally, Dogon Gao Awakas activities centred essentially on livestock raising. Following Dogon Gao Awakas' first reported drought, Ban Kanai (1928-29), agriculture became increasingly important in Dogon Gao Awakas. Dogon Gao Awakas' best years are identified as the decade preceding Dogon Gao Awakas' second reported drought, Tchikouma, (1966). Following Tchikouma, agriculture became Dogon Gao Awakas' principal activity. While agriculture became central, households in Dogon Gao Awakas report that, between Tchikouma and Dogon Gao Awakas' third reported drought, Kilo (1973-74), agricultural surplus allowed a partial reconstruction of Dogon Gao Awakas' herds. This process continued up to Kilo, when livestock losses ended herd re-construction. Following Kilo, agricultural surplus allowed partial herd reconstruction up to Dogon Gao Awakas' fourth reported drought, Kantchikalagie (1984). Table V.4 presents Dogon Gao Awakas' chronology.

Table V.4: Event chronology for Dogon Gao Awakas

	Event reported by the community members
1900s	Founding of Dogon Gao Awakas, Agatam Aboudalaye is the village chief, replaced (date not identified) by Rouga Harsonna
late 1920s to early 1930s	Ban' Kanai drought
1932	First village well
early 1930s to late 1960s	The pastoral space is structured
1942	Awakas Rouga becomes the village chief
1958	End of forced labour
1963	Loss of livestock to illness
1966	Tchikouma drought, agriculture becomes the village principal activity
1973-1974	Kilo drought, household dwellings stop moving, livestock corridors are narrowed
1974	Fire destroys homes in the village
1975 to 1983	Livestock corridors are widened
1978	Moussa Assaye becomes the village chief
1984	Kantchikalagie drought
1985	New village well
1985-86	Livestock corridors are narrowed
1995	Fire destroys homes in the village
1996	Cholera epidemics
1998	Drought (not named), death of Moussa Assaye

In terms of land use, the growing importance of agriculture between 1928-29 and 1966, led to a progressive structuring of the pastoral space. This structuring of the pastoral space consisted of the definition of livestock corridors connecting fallows, watering points, and points of entry in the village territory. Furthermore, before Kilo (1973-74), the location of the household dwellings changed every three to four years. As livestock were corralled in the vicinity of households at night, these movements allowed a better distribution of manure on the village land. After Kilo, these movements ceased definitively.

Field-level history reveals that while the transhumance corridors did not disappear, an important narrowing (to 66% of their original width, i.e., from 9-12 m. down to 6-8 m.) of these corridors occurred just after Kilo (1973-74). In the years after Kilo, livestock corridors were widened back to their original width. Just after Kantchikalagie (1984), the livestock corridors were narrowed again (up to 50% of their original width for the widest corridors). At the time when the fieldwork was conducted, the width was still as narrow.

Toudoun Wada

Originally, Toudoun Wada's land was inhabited temporarily during the rainy season only. The purpose of this temporary occupation was agriculture. It was only in the early

1930s that Toudoun Wada's land was settled permanently. While it is not possible to identify the year with more precision, this permanent settlement did occur in the five years following the 1928-29 drought. In the early 1940s, Toudoun Wada's first village chief was officially recognized by the colonial authorities. Toudoun Wada is, therefore, a fairly young village having agriculture as the rationale for its creation. This focus on agricultural activities is reflected by the fact that Toudoun Wada's good years are characterised mainly by agricultural production, livestock holdings being seldom mentioned. These good years are reported to have occurred before the Kilo drought (1973-74, Toudoun Wada's second reported drought) and in the years between the Kilo and the Kantchikalagie (1984) droughts. Since Kantchikalagie, the years are reported as difficult because of constant shortages of millet. The repetition of droughts and the increase in population are given as the cause for this decrease in the quality of life in Toudoun Wada. Table V.5 presents Toudoun Wada's event chronology.

In terms of land use, Toudoun Wada did not go through important noticeable change. Since its foundation, there were no livestock corridors on Toudoun Wada's land. Furthermore, during the rainy season, watering points have never been accessible without passing through cultivated land. Toudoun Wada's pastoral space is typically closed.

Table V.5: Event chronology for Toudoun Wada	Event reported by the community members
early 1930s	Permanent settlement of Toudoun Wada
early 1940s	Official recognition of Toudoun Wada, Askia Guidamou becomes the village chief
1946	First village well
late 1940s early 1950s	Loss of livestock due to epidemics
1952-53	Thebark/Gargui drought
1963	Mali Askia becomes the village chief
1973-1974	Kilo drought, household dwellings stop moving, livestock corridors are narrowed
1974	Rule re. rangeland use (ask permission) comes into effect
1980	New village well
1984	Kantchikalagie drought
1993	Two fields are given as guarantee on a loan
1998	Death of Mali Askia, Chahi drought

Field level history did yield the following two results. First, two large fields were given as a guarantee on a loan in 1993. These have not been cultivated since and represent almost 50% of Toudoun Wada's rangeland. Secondly, the rule whereby it is necessary to ask for permission before taking livestock to graze on fallows appeared following Toudoun Wada's second reported drought (Kilo, 1973-74). It must be noted that there is a general agreement that while it is necessary to ask, permission is always granted,

provided that the livestock are muzzled as they pass through cultivated fields. It must be noted, however, that owners of fields bordering watering points, or bordering fallows that are used as pastures, report losses due to livestock wandering accidentally into their fields.

V.5 Discussion

The drought-closure linkage and the avoidability of pastoral space closure

Table V.6 groups the key exogenous ecological events (droughts) identified in all four villages with the occurrence of events leading to the closure of the pastoral space. There is a clear pattern showing that, following drought years, rangeland is decreasingly accessible to outsiders. In Alkama, the range resource began to be harvested following the 1966 drought. In Banizoumbou, watering points were enclosed by fields and transhumance corridors were allocated to cultivation following the 1973-74 drought. In Dogon Gao Awakas, the width of transhumance corridors was dramatically reduced after the 1973-74 and 1984 droughts. Toudoun Wada's permanent settlement occurred following the drought in 1928-29. Furthermore, it is after the 1973-74 drought that, in Toudoun Wada, permission began to be needed to access a fallow.

Table V.6: Summary of droughts and their impacts on rangeland use/tenure

Year and names of the most important droughts	Village	Events linked to rangeland use and tenure
1928 - Ban' Kanaï 1952-53 - Gargui/Dawa/Teïbark	All	While these droughts were mentioned by some villages, no events linked to these were identified. It must be stressed that the impact of these drought is reported as minimal due to the existance of grain stocks.
1966 - Tchikouma/Garojire	Alkama	Begining of the harvesting of forage
1973-74 - Kilo/Albanajire	Alkama	In Alkama, the years following Kilo are chaterizable by an increase in the harvest of forage
	Banizoumbou	In Banizoumbou, the years Kilo+1 et Kilo+2 are the years were the transhumance corridors were cultivated and water became not accessible for outsiders.
	Dogon Gao Awakas	In Dogon Gao Awakas, the year Kilo+1 is characterized by a narrowing of the transhumance corridors (66 % of their original width) The years Kilo+5 and following are characterized by a widening of these corridor to their original width.
	Toudoun Wada	In Toudoun Wada, the post Kilo are characterized by the begining of the rule whereby one must ask permission to use a fallow as pasture.
1984 - (Kantchikalaguie/ Karamrami)	Alkama Banizoumbou Toudoun Wada	Nothing
	Dogon Gao Awakas	Re-narrowing of transhumance corridors (50 % of their original width) the Kantchikalaguié+1 year,Still narrow in 1999.

This apparent linkage between drought years may have three different theoretical explanations. The following sections will present these frameworks and discuss their explanatory power in terms of the analysis of the drought-closure linkage.

Shift from intensive agriculture to extensive agriculture

First, it has long been argued that, following drought years or following an increase in the occurrence of drought years, there is a definite incentive to practice more extensive agriculture (e.g., Eldin 1989). Following this argument, it would be possible to explain land use changes after droughts in terms of a consequence of more extensive agricultural practices. In southwest agro-pastoral Niger, this extension of agriculture would translate itself into a change in tenure (see Chapter III). This argument, when combined with population increase, frames the pastoral space closure as a direct and unilateral result of agricultural practices (e.g., Cleaver and Scheiber 1994). While this argument may have some value, it fails to explain more refined institutional changes, namely, permanent settlement and changes in rules in Toudoun Wada, changes in the spatial organisation of fields in Banizoumbou (not an absolute increase in cultivated area), and Alkama's harvesting of the range resource.

Changes in the cost-benefit structure of institutional change

A second theoretical framework, seemingly more adapted to explaining institutional changes, lies in new institutional economics (North 1990). Two major results of new institutional economics may be summarized as follow. First, institutional change is pathway-dependant and, therefore, specific historical local contexts are fundamental in explaining institutional changes. Second, institutional change will occur when the expected benefits of the change outweighs its costs. Using these broad results leads to a three-step process: the identification of the cost-benefit structure of the change that is observed; the identification of how drought may have an effect on the cost and benefits of institutional change; and the analysis of local history's specific differences in order to understand differences in the way institutional change is implemented.

Pastoral space closure dynamics have the following potential benefits: appropriation of the range resource, avoidance of crop destruction by livestock, and extension of cultivated area. It has the following potential costs: loss of manure coming from transhumant herders, loss of connections with herders to engage into transhumance contracts, and increasing risk of conflicts with herders.

While it is not the prupose here -- it would be quite difficult -- to quantify the relative

importance of these costs and benefits, it is possible to analyse the potential impact that a drought may have on these elements. In terms of appropriation of the range resource, droughts have the impact of lowering its value significantly. Droughts are characterized by major livestock losses for agro-pastoralists and pastoralists. Post-drought years (i.e., years following closely after drought years) are, therefore, the years when the potential benefits of rangeland appropriation are the smallest. When considering damage to crops by livestock, drought years are not years where the risk of damage to crops is the highest because of the important livestock losses. Finally, extension of cultivated areas is effectively a rational post-drought agricultural strategy. Nevertheless, as mentioned above, this does not explain range appropriation without extension of the cultivated area. The benefit structure seems to indicate that post-drought years should not be years when pastoral space closure occurs. While this may seem *a priori* contrary to the empirical evidence, the analysis of the impact of drought on costs sheds a different light on the question. The loss of manure, following the argument that post-drought years are years of extensive cultivation strategies, is not as important in post-drought years. Furthermore, during post-drought years, widespread livestock losses have the consequence that manure is not available. Similarly, livestock losses have a consequence that, during post-drought years, the need for transhumance contracts does not exist. Finally, and this is a major argument, during post-drought years, risk of conflict with transhumant herders is non- existent A focus on the cost side of the cost-benefit structure

indicates that post-drought years may be understood as years where a window of range appropriation opportunity exists. Post-drought years are the only years when a major closure cost may be avoided, namely, conflict with transhumant herders. This allows an investment at minimal costs for the purpose of capturing the benefits on more normal years.

The final step consists in analysing why the different villages chose different ways to implement pastoral space closure. When comparing Alkama and Banizoumbou, a major difference lies in the number of watering points. In Alkama, the water table is near the surface of the ground. This leads to a situation in which pastoral space closure through the control of access to water (as in Banizoumbou) would be totally impractical. With Dogon Gao Awakas and Toudoun Wada, again the control of access to watering points in Dogon Gao would be difficult. Furthermore, the need to be able to water cattle is perceived as much more important in Dogon Gao Awakas because of an important tradition of livestock raising. Therefore, range appropriation pathways seem to be a function both of the relative importance given to livestock and of the ease with which access to a key resource – water – may be implemented.

Changes in the opportunities for expressing competing claims

Third, a theoretical argument developed by Rose (1994) may be used. Rose demonstrates that appropriation (i.e., the laying of a successful property claim) is conditional on two elements: the claim has to be known to all interested parties and the claim may not be challenged successfully. Furthermore, Rose (1994) demonstrates that laying a property claim may take several forms: claim through administrative channels, investment in the subject of the claim, management of the item that is claimed, public appropriation, and enforcement of exclusion. Using this framework, pastoral space closure may be construed as a claim on the property rights to the range resource by agro-pastoralists. During non-drought years this claim would be – and is – challenged by other users (transhumant herders) of the pastoral space. The only way that exists to express this challenge is by bringing livestock on the rangeland (over which the claim is laid). During post-drought years, other users are unable to challenge this claim due to livestock losses. It is, therefore, during post-drought years that range appropriation may occur.

Is pastoral space closure avoidable?

These three analyses allow the exploration of the following question: "is pastoral space

closure avoidable"? First, empirical evidence from the results of this chapter indicate that pastoral space closure has not been avoided in any of the four villages. Nevertheless, this closure occurred to different extents and through different means. In Dogon Gao Awakas, the width of livestock corridors has diminished, yet range resources and water resources remain accessible to outsiders. In Alkama, outsiders are still able to pass through the village land; nevertheless, the resource is harvested which limits the possibility for outsiders to stay on Alkama's land. In Toudoun Wada, the pastoral space has always been not accessible to outsiders. In Banizoumbou, access to the water resources and the range resources has been restricted. As noted above, these differences may be attributed to the relative ease (both physically and culturally) with which access to resources may be curtailed. There is very little control over these features and pastoral space closure may, therefore, seem unavoidable.

Nevertheless, this linkage between drought and pastoral space closure may lead to ways of reducing the pastoral space closure provided that there is a strong political will to that effect. First, post-drought years being critical, it is clear that land-use changes during these years should be monitored. Secondly, post-drought years occur when key rangeland users are unable to keep their use-right. Designing institutional pathways that allow an outsider to lay a use-right claim even without livestock would stop agro-pastoralists' claims from going unchallenged. Thirdly, as livestock losses are the major

causal factor resulting from drought, pro-active policies aimed at reducing these losses and at supporting rapid herd reconstruction could be envisioned. Finally, a characterisation of villages could be established, identifying which village's land are the most at risk of closure, thus allowing a more efficient monitoring.

These four approaches are conditional on a strong political will and the allocation of resources for monitoring purposes. Considering southwest agro-pastoral Niger's history of prioritization of agricultural activities over pastoral activities, these avenues seem unlikely to be pursued. If pastoral space closure avoidance is important in order to keep livestock mobility, it is worth exploring whether this closure may be reversed and, if so, how. This is the purpose of the next section.

The reversibility of closure

Among the four villages studied, only Dogon Gao Awakas went through a period in which pastoral space closure was reversed. Between the 1973-74 drought and the 1984 drought, livestock corridors were re-widened. This indicates that there is at least one empirical instance where pastoral space closure was reversed. When analysing Dogon Gao Awakas' local event chronology and comparing it with household-level interviews and the history of livestock holdings, the following pattern emerges: the width of

livestock corridors in Dogon Gao Awakas is directly linked with its population's livestock holdings. This observation is particularly powerful. It seems to point to the fact that, for the pastoral space to re-open, there is a need for an incentive for agro-pastoralists. This incentive is the practice of livestock raising. These results shed particular light on the preceding results. The closure of the pastoral space may be construed as a partial result of a lack of commonality of interest between agro-pastoralists and transhumant herders.

The combination of the results of the present section with the preceding section leads to the following conclusions. First, pastoral space closure is intimately linked with droughts. Secondly, droughts have this effect through their impact on livestock losses. Thirdly, pastoral space closure may be reversed, and maybe avoided, through the nurturing of a commonality of interests between agro-pastoralist communities and transhumant herders. Finally, this commonality of interest is best achieved through the joint practice of livestock raising activities. These results mirror those of Chapter IV. Chapter IV shows that livestock raising for agro-pastoralists is dependant on traditional pastoralists being still engaged in livestock raising in order to allow agro-pastoralists' livestock mobility.

The current Chapter demonstrates that traditional pastoralists depend on the ability of

agro-pastoralists to practice livestock raising. There is a clear complementarity between both populations. Community-level rangeland management in southwest agro-pastoral Niger is, therefore, clearly dependant on the ability for these two groups to cooperate. The next Chapter will explore the issue of cooperation between these groups.

CHAPTER VI: AN ASSESSMENT OF THE POTENTIAL OF LOCAL INSTITUTIONS TO FOSTER COOPERATION[1]

Chapter IV demonstrates that rangeland in southwest agro-pastoral Niger is managed by agro-pastoral communities when intra-community cooperative dynamics are strong. It also indicates that mobility is fundamental both as a local rangeland management tool and a rent-capture mechanism. One of the major consequences of these results is the fact that livestock raising by agro-pastoral communities is dependent on livestock mobility and that, therefore, rangeland in southwest agro-pastoral Niger has to allow for this mobility to occur. Another key result of Chapter IV is the fact that agro-pastoral communities in southwest Niger depend on transhumant herders for the mobility of their livestock.

Chapter V shows that a closure of southwest Niger pastoral space is occurring through the direct (i.e., by the enclosure of pastures) and the indirect (i.e., by the closure of transhumance corridors or the enclosure of watering points) control of access to rangeland by agro-pastoral communities. This closure is reversible and discontinuous. Furthermore, Chapter V indicates that this closure may be avoided through the development and nurturing of a commonality of interest between agro-pastoralists and transhumant herders.

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[1]Earlier version of parts of this chapter is presented in Vanderlinden (2000a).

The results of these two chapters point to the fact that there is a need for agro-pastoral communities to be able to cooperate in order to manage their rangeland. These results indicate as well that inter-community cooperation (between agro-pastoralists and transhumant herders) is fundamental. A final issue that remains to be addressed is the role that traditional institutions could play in fostering such cooperative dynamics.

The purpose of this chapter is, therefore, to test the following hypothesis: traditional local institutions have the capacity to play a role in the management of rangeland. In order to test this hypothesis, a conceptual framework is developed. This conceptual framework is then formalized using social network theory and applied to the question at hand. The conceptual framework that is developed finds its origin in conflict resolution/cooperation theory. The interest in analysing the relationship between conflict, cooperation, and CPNR-use lies at two levels.

First, growing resource scarcity often leads to the appearance of open conflicts which disrupt both social and economic relations (e.g., Bassett 1993, Rogers 1996). The disruptive effect of natural resource-based conflict shifts the cost structure that the parties are facing (Ensminger and Rutten 1991, Platteau 1996). This shift of the cost structure may call for new institutional arrangements. Conflicts appear when perceived competition between parties is more important than cooperative behaviours between the same parties. The outcome of a conflict will be linked to the level of cooperation that can

be established during the conflict between the parties in conflict. If cooperation is impeded, the outcome of this conflict may be destructive and the adaptation of the institutional environment to the growing resource scarcity may be stalled. The purpose here is, therefore, not to belittle the well-documented positive aspects of conflicts (e.g., Deutsch 1973, p. 170, Filley 1975, pp. 4-7, Fisher and Ellis 1990, pp. 259-260, 263-268, Folger et al. 1993, p. 1, Jandt 1973, pp. 3-4, Mack and Snyder 1973, pp. 51-53, Ross 1993, p. 76). The purpose here is to assess whether local institutions will contribute to the realization of these positive outcomes.

Second, stakeholders involved in the joint exploitation of CPNRs are facing a dilemma. They are competing for the same resource; they are competing for a share, as big as possible, of the "resource pie." They have an incentive to engage in cooperation to manage the resource through the provision of a management institution; they have an incentive to cooperate in order to increase the size of the "resource pie." While these types of social dilemmas have been exhaustively studied, most modelling exercises focus on linking the initial conditions to the possible outcomes while neglecting the negotiation process through which these outcomes are achieved (Putnam and Folger 1988, Putnam and Roloff 1992). Conflict analysis is an important exception. A growing body of empirical evidence shows that, regardless of initial conditions, social dilemma outcomes are defined by the negotiation processes and the nature of the communicative events linked with them (e.g., Tutzauer and Roloff 1988). Analysing social dilemmas through

the "conflict analysis lens" may help us to understand how the negotiation process and its local institutional environment may contribute to the definition of the outcomes.

VI.1 Conceptual development

Conflict analysis

Conflict situations have been analysed by several disciplinary fields. Economists and mathematicians, for instance, mostly use a game-theoretic approach, focussing on the initial conditions and on the possible outcomes (e.g., Gilson and Mnookin 1992, Varoufakis 1991). Political scientists, on the other hand, focus on the power relationship between parties, while psychologists focussed for a long time on transactional analysis, i.e., the analysis of communication framed as the parent/child/adult relationship (e.g., Filley 1975). The integration of these different disciplinary fields led to the emergence of the relatively recent interdisciplinary field of conflict analysis/resolution theory (Levinger and Rubin 1994, Putnam and Folger 1988). The purpose of this section is to present the key elements of conflict analysis that will be used hereafter.

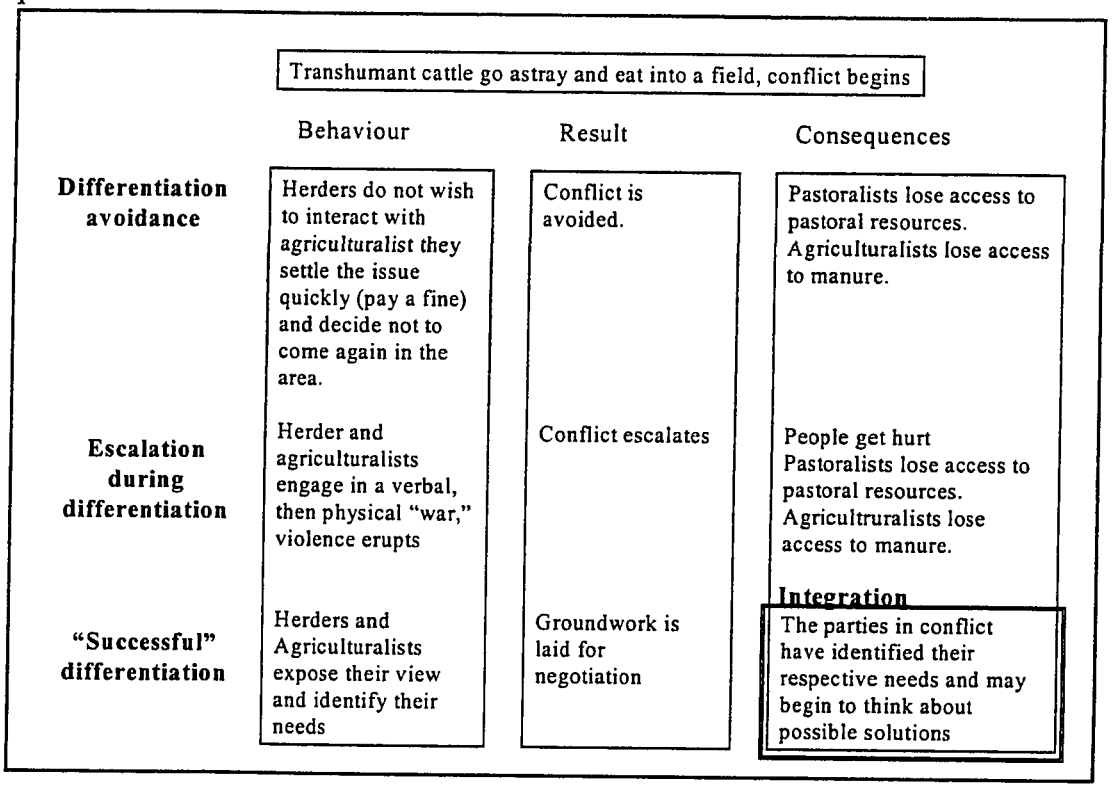
All conflicts share some common traits (Levinger and Rubin 1994). Conflicts stem from perceived divergence of interests; can be addressed in a small number of ways; contain

mixed motive relations (e.g., the "share of pie vs. the size of the pie" issue); can be ended through behaviour and/or attitude changes; lead to outcomes that can range from purely constructive to purely destructive; and stem from a broad variety of causal antecedents. The ways that conflict can be addressed are capitulation, withdrawal, inaction, negotiation, and third party intervention. Such a generalization may seem excessive. Nevertheless, most of the debate on the impact of cultural differences, for instance, on conflict theory lies more in the implementation of negotiation rather than on the conceptualization of conflict dynamic (e.g., Gulliver 1979).

In the course of the present chapter, the focus will be on negotiation having as an objective a constructive outcome. The prerequisite for negotiation or conflict management, leading to settlement or to resolution, is the existence of cooperation (conflicts being mixed-motive situations). To analyse conflict and the risk of conflict escalation, the following section will present some of the properties of conflict dynamics that can have an impact on conflict outcomes. The first property is linked with the centrality of communication patterns in the definition of a conflict outcome. The second property, akin to the "political science" approach to conflict analysis, deals with an important initial condition, i.e., the power relationship between parties. The third property is linked with patterns of behaviour that may have an impact on conflict dynamics. While the distinction of these properties has a definite analytical interest, they can interact and be redefined by the conflict dynamic itself.

The first property of conflicts has been phrased as follows: "Conflict moves are embedded in larger interaction sequences" (Folger et al. 1993, p. 80). There exist several models describing phases in conflict (Filley 1975, pp. 7-8, Fisher and Ellis 1990, pp. 274-275, Holmes 1992). The focus in this chapter is on Walton's two-phase model (Folger et al. 1993, pp. 82-86). Walton divides conflicts into two phases: differentiation and integration. The differentiation phase consists of the parties building a clear assessment/definition of their differences and the rationale behind these differences. Integration is a phase where, after differentiation, the parties engage in the search for common ground and work toward the resolution of the conflict. This distinction is more analytical than chronological (Ross 1993, p.78). During the differentiation phase, the conflict may be de-personalized, through the definition of the issues separately from the human elements. This allows the parties in conflict to focus on the issues rather than on the persons during the integration phase. Differentiation is a critical part of the conflict process because it can lead to escalation if the differentiation goes too far or it can stall through differentiation avoidance, impeding the conflict from moving toward integration (see Figure VI.1). The fundamental importance of these phases led Ausburger (1992, p. 47) to use their description to differentiate destructive conflict from constructive conflicts. The risk of escalation during differentiation can be attributed to the following behavioural hypotheses that have been validated in empirical settings (Folger et al. 1993, pp. 83-84): people try to maintain consistency between their beliefs and feelings (balance theory), which may lead to a personalization of the conflict thus impeding a clear identification

Figure VI.1: Hypothetical scenarios illustrating the importance of the differentiation phase in conflicts



of the rationale underlying the conflict; if a remark is perceived as aggressive it is likely to induce an unfriendly response (research on interpersonal reflexes), thus engaging the conflict in a spiral of escalation and personalization (see also Putnam and Folger 1988); and public statements can lead parties to a loss of flexibility (research on the nature of commitments) (see also Semlak and Jackson 1975, p. 27). In mediated conflicts, the mediator's competence is often assessed in terms of being able to control communication (e.g., Donohue 1989, Semlak and Jackson 1975). In successfully mediated conflicts, conflict-escalating information is minimized by the mediator while integrative information is highlighted. Finally, the differentiation and integration phases are always

observed in successfully managed conflicts. The integration phase is absent in most unsuccessfully managed conflicts.

The second property of conflicts has been phrased as follows: "Conflict interaction is sustained by the moves and counter moves of participants; moves and counter moves are based on the power that participants exert." (Folger et al. 1993, p. 69) Central to this property is the importance of the power relationship between the conflicting parties. Balanced power relationships may help conflicts to maintain a constructive direction (Filley 1975, p. 90, Folger et al. 1993, p. 117, Poole et al. 1992, pp. 58-59, Ross 1993, pp. 110-112, Semlak and Jackson 1975, p. 28). If a party believes that, because of its dominant position, he or she can be inflexible, there is little incentive for this party to compromise. Furthermore, in an unbalanced conflict situation, the weaker parties' needs may not be seen as legitimate. A typical example of this can be found in Niger where in the agro-pastoral zone, pastoral authorities are disadvantaged in terms of bargaining power over land issues (Ngaido 2001). If a conflict erupts between agro-pastoralists and pastoralists, pastoralists have very little recourse outside of violence and/or conflict avoidance.

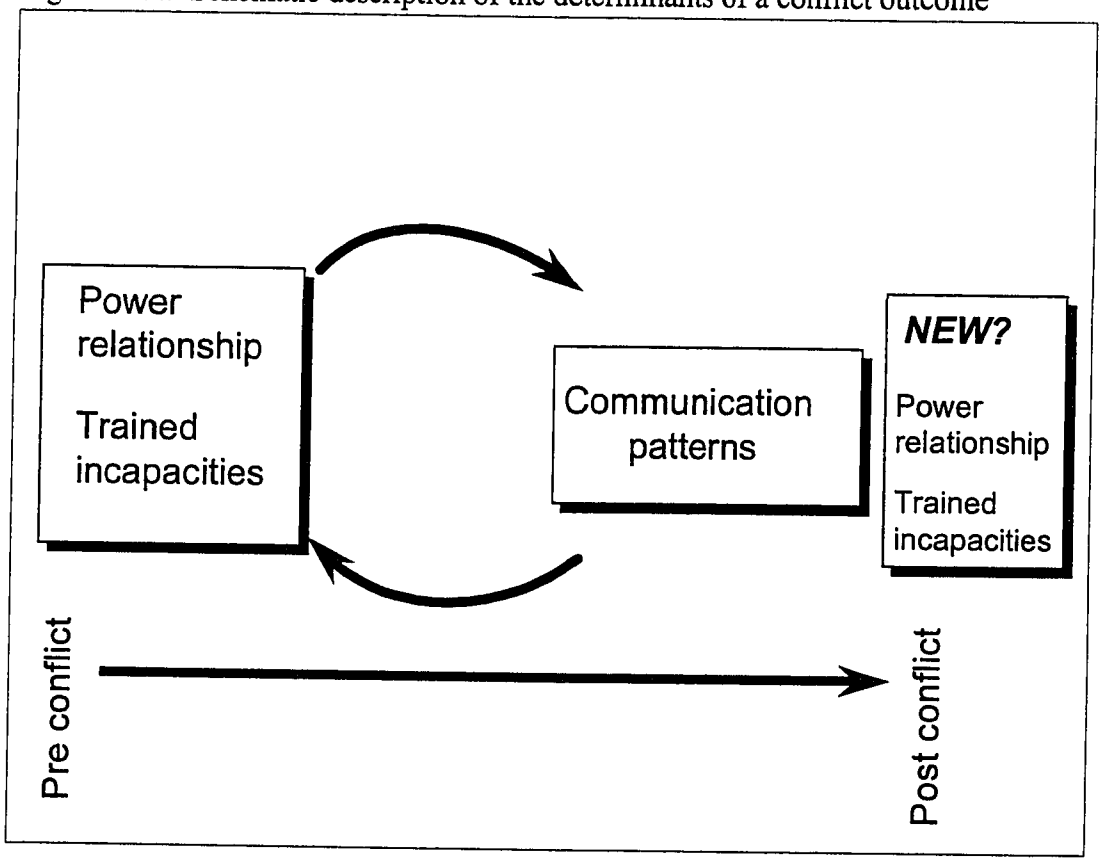
The third property shared by conflicts has been phrased as follows: "Patterns of behaviour in conflict tend to perpetuate themselves" (Folger et al. 1993, p. 70). Central to patterns of behaviour having the potential to perpetuate conflict are what Folger et al. (1993, pp.

72, 75-79) call "trained incapacities." They identify the following three "trained incapacities." First, goal-emphasis becomes an incapacity when it prevents parties from conducting an adequate assessment of the problem underlying the conflict, or when it becomes a way to decide quickly without a complete analysis of the chosen solution. An instance of goal emphasis can be found in central Niger where most regulations re livestock mobility are geared toward the avoidance of livestock going astray into cultivated fields. This misidentified objective leads to a marginalization of all interactions between pastoralists and agriculturalists. Second, with objective standards, the conflict can encourage members to presume the existence of objective standards in cases where there are none. This may lead to the misidentification of the path leading to the conflict management. Third, procedures can become incapacities when they structure interaction so that confrontation and escalation cannot be avoided.

Key lesson from conflict analysis theory

The purpose of the preceding section was to identify key elements that may impact on a conflict outcome. To summarize, three elements of the general environment may have an impact on conflict dynamics (see Figure VI.2): communication patterns, the power relationship between parties in conflict, and patterns of behaviours that predated the conflict. The purpose of the next section is to analyse how institutions as part of a dynamic environment may have a role in the definition of these three elements.

Figure VI.2. Schematic description of the determinants of a conflict outcome

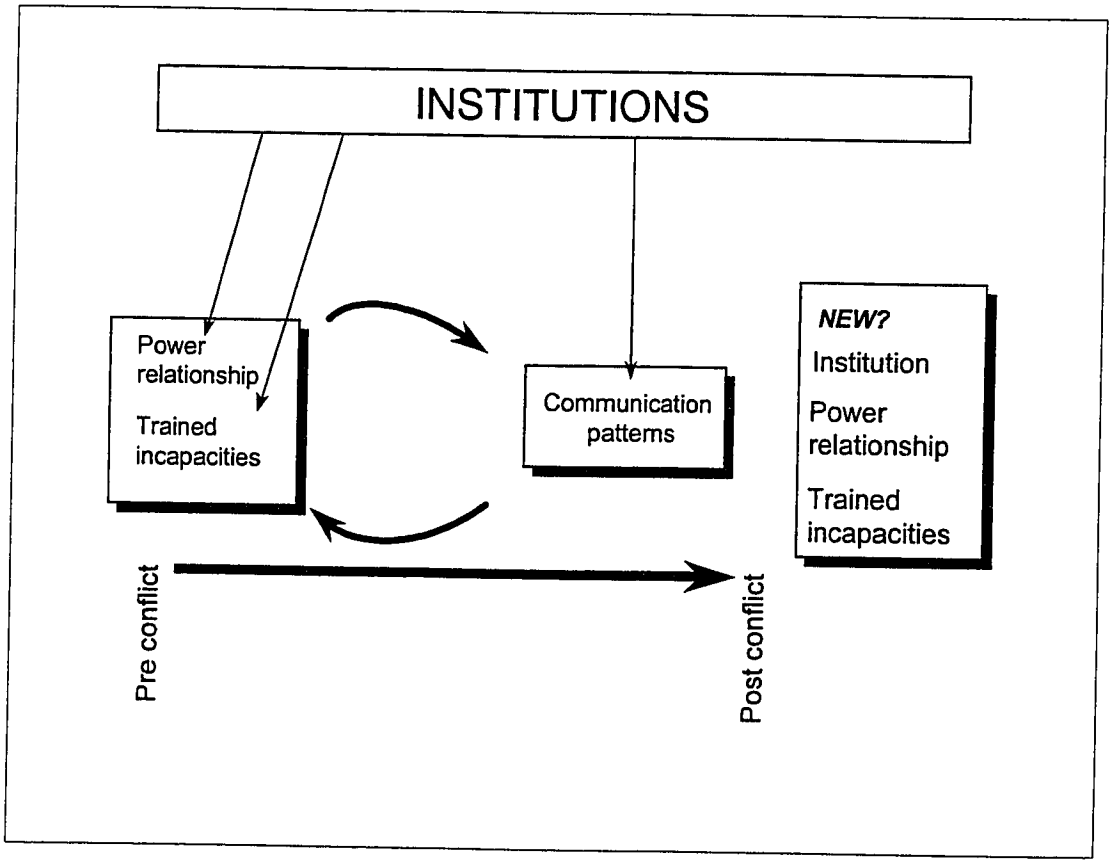


VI.2 Assessing institutions

When analysing institutions and conflict stemming from natural resource exploitation and management, one can present a schematic representation of the situation. Once a conflict

arises (i.e., once parties are competing for the resource), it will take a path leading to a position in the continuum between total competition and total cooperation. The level of conflict management will depend on the blend of cooperation and competition between parties in conflict. The hypothesis that is the basis of the present conceptual model is as follows: local institutions, more or less involved in CPNR exploitation and management, will play a major role in the definition of this blend. The way to analyse this impact is to assess the effect of the institution on communication, power balance, and patterns of behaviour (see Figure VI.3).

Figure VI.3. Schematic description of institution and conflict characteristics interactions



Communication

For the purpose of the present framework, communication patterns are the characterization of communication in terms of localization (i.e., where are the different points or nodes where information is exchanged?). While quantitative considerations (i.e., how often is information exchanged?) and content (i.e., how is the information transformed when it passes through a node) are important, they will not be covered here due to methodological constraints. Quantifying communication involves either a constant presence of the investigator, or the setting-up of self reporting tools (e.g., diary). Both are time-consuming for the investigator or for the subject and can, therefore, be implemented for the analysis of relatively "micro" events which is not the case here. The analysis of content and its transformation involves the presence of the investigator for data collection and involves highly sophisticated qualitative tools including the use of referees who are able to frame communicative events according to the diverse experiences of the parties involved.

The assessment of an institution's contribution to communication patterns poses a series of difficulties. First, most of the analysis of communication's impact on conflict is limited to face-to-face negotiation, mediated or not by a third party. Communication for resource management can take many forms and may involve a large number of actors. A first challenge lies, therefore, in applying to a "macro" event a conceptual framework

dealing mostly with "micro" event analysis. Furthermore, actors competing over resource use have a choice of communication media (e.g., face-to-face, mediated by the market, etc.). Identifying the relevant media before focussing on it is, therefore, a second challenge. The way to address this issue lies in the realization of the mapping of communication through the characterization of the communication nodes, i.e., identifying where, when, and through what communication medium parties are communicating. Once this mapping, i.e., the identification of the structure (Blau 1982, Rogers 1979) of communication patterns, is realized, one can assess the importance of the impact of the institution on communication between stakeholders.

Power

When analysing the contribution of local institutions to power relationships, one must clearly delineate in which realm of socioeconomic activity this imbalance occurs. If there is an imbalance in power between parties, one must assess how exactly it manifests itself. Once this is understood, one must assess whether this power imbalance is part of a broader context or whether it is due solely to the institution under scrutiny. If it is a part of a broader context, one can assess whether the institution that is considered replicates, reinforces, or diminishes the power imbalance between parties.

Behaviour

Through their normative and cognitive structures, institutions can lead to the existence of misidentified "objective standards." The regulatory structures of institutions can contribute to the existence of incapacitating procedures. An instance of an institution's normative and/or cognitive structure that could lead to misidentified objectives is the school system if it puts an emphasis on competition rather than on cooperation or personal development. The competitive behaviour that results may hinder personal development and societal development. An instance of a regulatory structure that led historically to incapacitating procedures is the judicial system. By following strict judicial procedures, conflicts that could be resolved by alternative means are resolved often with long delays and high costs (e.g., Gilson and Mnookin 1992).

Communication networks analysis as an integrative tool to analyse cooperation and conflict

When analysing institutions, it is tempting to use the proposed conceptual framework by assessing separately, and eventually with different approaches or methodologies, the aforementioned different elements of conflict, namely, power, behaviour, and communication. While such a disjointed approach may seem tempting, it presents the risk of losing the interconnectedness of these elements as well as their possible

interactions (see Figures VI.2 and VI.3). Another approach, which is proposed here, is to analyse the structure of the social relationship between parties and assess the contribution of the institutions under scrutiny to this structure. This analysis can be achieved through the analysis of the communication network (Blau 1982, Rogers 1979,Weimann 1994) linking members of the parties that are interacting. The analysis of the communication network allows the assessment of the institutional environment in terms of its impact on power relationships, patterns of behaviour, and communication. From a methodological point of view, communication networks can be identified using different approaches. (For a review of these and their respective characteristics see Bernard et al. 1987, Bernard et al. 1990, Monge and Contractor 1988, Weimann 1994, pp. 29-51.) For the purpose of this analysis, the most appropriate method is the use of name generators (Burt 1984). Name generators are short questions having a person's name as answer , e.g., "The last time you wanted to use manure on your fields, who is the first person you talked to about your plan?" This technique is particularly appropriate here because it allows a stratification of the questions by realm of socioeconomic activities (see below). Finally, this approach allows the use of snowball sampling, thus giving a partial guarantee that all actors involved will be taken into account.

Communication can be analysed in terms of the communication network as a whole. When identifying and characterizing the communication network, much care must be given to the "dredging up" (Bernard et al. 1987) of the relevant part of the total network.

Once the network as a whole is analysed, it is possible to identify and quantify the contribution of the institutional environment to the communication structure. In order to identify from which realm of socioeconomic activity this communication structure stems, two analytical approaches can be combined. First, the stratification of the name generators by realm of socioeconomic activity allows the identification of the rationale behind the presence of an individual at a certain position in the network. Second, the understanding of the institution under scrutiny allows the design of a (theoretical) sub-network which can be compared with the actual network that is observed.

Power relationships can be proxied using the characterization of key individuals through which information must pass and key individuals having access to more information. This corresponds to the two principal concepts of centrality in social network theory and is often considered as representing/being a proxy for the analysis of power distribution (Freeman et al. 1991). Again, the two approaches described for the analysis of communication can be combined. Furthermore, an analysis of the linkages between control over information, control over assets, and position of the family in terms of relationship to the traditional authorities can be conducted. This would allow a validation or a rejection of the use of network centrality as a proxy to power.

Patterns of behaviours can be analysed in terms of the path that information is taking to reach different nodes and in terms of the degree of centralization of the network

(Bonacich 1987). Again, the two approaches described for the analysis of communication can be combined.

VI.3 Institutions under scrutiny

Choosing institutions

The choice of the institutions that will be analysed is dictated by the analysis and results of the two preceding chapters. The two fundamental criteria for choosing an institution were that it has to (a) mediate relationships among members of the agro-pastoral community and/or (b) mediate the relationships between community members and outsiders using the range resources of the community. Five kinds of institutions are analysed: those dealing with land tenure, traditional local authority, family relationships, manure contracts, and transhumance contracts. In the following sections, "herders" will refer to transhumant herd managers/keepers passing through the land of a village practising agriculture; and "agriculturalists" will refer to the members of the agro-pastoral communities through which the "herders" are passing.

The fact that Niger is trying to implement a new rural code which should increase the importance of local resource management institutions justifies the focus on local

institutions. Furthermore, there are difficulties in the implementation of the rural code due to a clear lack of understanding of how these local institutions function (Elbow 1996, Gado 1996, Ngaido 1993a, 1993b,).

The focus on land tenure has the following interesting characteristic. Land being a multiple-use resource, conflicts that stem from scarcity may also stem from a difference in the way that parties perceive how land should be used. This allows the joint analysis of scarcity-based conflicts mediating institutions and value-based conflicts mediating institutions.

While a majority of conflicts between transhumant herders and agriculturalists in western Niger are still settled at the village level, there is an apparent continual increase in the use of courts to settle pastoral resource related conflicts (Ngaido 1993b). This seems to indicate that local conflict settlement institutions may be losing progressively the exclusivity to perform their function or/and that these institutions may be undermined and thus rendered ineffective by forum shopping. This calls for the analysis of traditional authority as a mediating institution. Finally, family relations are assessed because of their historical importance in defining tenurial status and local power.

When considering interactions between herders and agriculturalists, these are mediated by two supplementary institutions. Transhumance contracts, which are contracts whereby

agriculturalists entrust their livestock to herders during the transhumance, are a first institution that is assessed. Manure contracts, which are contracts whereby herders accept to park their livestock on agriculturalists' fields in order to provide manure, are a second.

Land tenure

When analysing the context of land tenure systems and their associated property rights, one must stress the dual nature of property rights. Property rights mediate the relationship between the resource and humans (Schlager and Ostrom 1992), and property rights mediate the relationship between humans (Lynch and Alcorn 1994). Therefore, contextual information has to deal with the human-resource relationship and with the human-human relationship. Land tenure systems in Niger are facing pressure on both fronts. Rainfall variability and population increase are sources of transformation for the human-resource relationship. Political changes have an impact on the transformation of the human-human relationship. There is, therefore, a need to stress that, when conducting an analysis of a land tenure institution, one must not lose sight of its dynamic dimension. Nevertheless, the analysis that is proposed here will be limited to the static analysis of the current land tenure arrangements and their historical context. Most of the information on land tenure can be found in Chapters III to V.

Traditional authority

Traditional authority is embodied by the *Chef de village* (i.e., village chief) and his *entourage* (i.e., advisory council to the village chief). The village chief is chosen by the administrative authorities. Nevertheless, the criteria that are used by administrative authorities are mostly based on traditional considerations that specify that a village chief has to be a descendant or a close family member of the village's founding family. His advisory council consists essentially of descendants of the families that first settled in the village lands. The authority of the village land pertains mostly to land tenure. Nevertheless, the involvement of village chiefs touches, theoretically, most realms of village life. Furthermore, the village chief is the link between higher traditional authorities (i.e., *Chefs de canton*) and administrative authorities (i.e., *Chef de poste administratif* or *Préfet*). As noted above, there is some evidence that his authority may be diminishing (e.g., through forum shopping which is the ability for a individual, when an issue arise, to choose the authority that is most likely to settle the issue in the individual's favour).

Transhumance contracts

Transhumance contracts are verbal agreements by which agro-pastoralists entrust their livestock to transhumant herders. It is a key tool for the management of agro-pastoralists'

livestock mobility. While the management of livestock mobility has been described in the past for Niger Fulani and Twareg (e.g., Bellot 1980, Dupire 1972, Wilson 1984), very little information exists on its recent development. While Turner (1998) gives a detailed account of the impact of the changing political environment on the herd management practices of Fulanis in the Say *département*, (e.g., "death" of grouped herds, changing roles of the transhumant leaders) very little exists on the current herd management practice of the Fulani, Zarma, Haussa, and Bella in western Niger as a whole. Furthermore, following the last two major droughts, there is evidence from eastern Niger that Haussa herd management practices may be evolving rapidly, relying increasingly on livestock mobility (e.g., Amoukou et al. 1996, Banouin et al. 1996). The knowledge base on livestock mobility and transhumance contracts that is used here stems, therefore, mostly from the results presented in Chapters IV and V.

Manure contracts

Manure contracts (or corralling contracts [Neef 1998]) are verbal agreements between agriculturalists and herders. The objective of these contracts is to concentrate manure on the field of the agriculturalist who is engaged in the contractual relationship. These contracts occur during the dry season when transhumant herds are foraging on dry pasture and crop residues. Their role in terms of nutrient transfer may be quite important, fields where corralling occur receiving up to 13 times more manure than fields with no

corralling (Hiernaux et al. 1998).

VI.4 Method

The research linked with the present chapter has been conducted through structured interviews. These interviewed relied on the questionnaires that are presented in Appendix 5. The use of questionnaires to analyze institutions is not sufficient in itself. Nevertheless, it is important to note that the present chapter is integrated within the larger research of the present dissertation. Furthermore, the theoretical development that are presented here above allows for the use of the method that is chosen here.

Household-level interviews were conducted in Dogon Gao Awakas and in Banizoumbou between November 1998 and February 1999. Due to time constraints, these villages were selected among the four villages where the historical events analysis was conducted (see Chapter V). The location of these two villages is indicated on Figure V.1. Key characteristics of these two villages are given in Table V.1 while a general description of these villages is given in Chapter V. A snowball sampling (Monge and Contractor 1988) procedure was used, starting with a core sample of 20 randomly chosen households (the household list constructed for the field work linked with Chapter V was used). The total sample of Dogon-Gao-Awakas consisted of 56 households. The total sample for

Banizoumbou consisted of 74 households. In each village, the interview framework was pre-tested by an interviewer under the supervision of the author. The author supervised the administration of the first twenty interviews in each village, then the author paid regular visits (every eight to ten days up to December 1998) to the field sites and stayed at least one night in each village during each visit.

The interview framework was divided into three sections. (The survey tools for this chapter are presented in Appendix 5.) The first section dealt with field use and tenure, as well as with manure contracts on the fields that are cultivated by the household. A second section dealt with livestock and covered issues linked with livestock keepers for transhumance. A third section dealt with communication and consisted of stratified name generators and of questions pertaining to communication with family members outside of the household.

In the section regarding land tenure, the number of fields cultivated by the household was recorded as well as their mode of acquisition. Households' fields that were cultivated by non-household members were recorded as well. For a sub-sample of 20 fields, fields were measured and their size was recorded. For each field, characteristics regarding use (i.e., cultivated field or fallow) and management (i.e., manure contracts) were recorded.

In the section regarding livestock management, questions pertaining to the feeding of

small ruminant and cattle were asked separating the dry and rainy seasons. This section included sections on transhumance contracts identifying the livestock keeper.

In the section pertaining to communication, name generators were organized the following way. For each name generator, three names were recorded and the rationale for choosing the individuals was recorded. The last time that communication pertaining to the subject covered occurred was recorded. Finally, two more general questions were asked. The first one consisted of the identification of the ten non-family members with whom the interviewee was the most likely to communicate. The second consisted of the identification of five non-household family members with whom the interviewee met most often. It included precision as to the relation between the interviewee and the five persons who were mentioned.

These interviews were analysed by characterising the following elements: linkages in terms of land tenure, linkages in terms of family relationships, and linkages in terms of communication. Relation to the traditional authority was observed during the fieldwork linked with Chapter V. Linkages with herders through transhumance contracts and/or manure contracts were characterized as well.

A different interview framework was used for transhumant herders who were identified during interviews with agriculturalists. The interview framework was divided into three

sections: transhumance routes and herd ownership, access rules to pastures during transhumance, and the choice of specific pastures and the rationale for that choice.

VI.5 Results

Stratification of communication

In terms of the stratification of communications, a first result must be noted. In Dogon Gao Awakas, the different strata do not lead to the generation of different names (i.e., villagers in Dogon Gao Awakas talk to the same persons regardless of the subject of the conversation). This indicates that there is no specialisation of communications. In Banizoumbou, communications are stratified when considering two activities. First, name generators pertaining to market transactions generate the name of individuals established as buyer or seller at the nearest regional market, Balleyara (16% of the names). Second, names pertaining to health issues generated the name of a midwife (56% of the names that were generated with the question pertaining to birth) or the name of the nurse in charge of Balleyara's health centre (7% of the names generated by the question pertaining to illness). Communications pertaining to other realms of activity are not stratified. This lack of communication specialisation in Dogon Gao Awakas and the reduced level of specialisation in Banizoumbou seems to point to the existence of one

"key" institution defining most communication or social relations. The following sections allows the identification of this key institution (i.e., kinship).

Land tenure

When analysing relationships in terms of land tenure, a first item to analyse is the mode of land acquisition. Table VI.1 presents the number of fields classified by type of acquisition for Banizoumbou and Dogon Gao Awakas.

Table VI.1: Land use, mode of land acquisition for Banizoumbou and Dogon Gao Awakas.

	Banizoumbou		Dogon Gao Awakas	
	Number	Percentage of total	Number	Percentage of total
Number of households surveyed	74	54	56	46
Total number of fields	206	100	114	100
Cultivated fields	98	48	83	73
Fallow	108	52	31	27
Acquisition through inheritance	155	76	100	88
Borrowed	27	13	3	2.5
Guarantee on a loan	15	7	10	8.5
Bought	9	4	1	1

The results presented in Table VI.1 show that land acquisition is still mostly through inheritance and is still mostly linked with family ties (i.e., the father shares his land holding between and among his sons). Only 11% of the fields in Banizoumbou and 9.5% in Dogon Gao Awakas may be considered as being the subject of monetary exchanges (i.e., purchase or guarantee on a loan). This indicates a fundamental feature regarding the importance of the strong relevance of the local land tenure institution. This shows as well that family ties remain a central feature in the organisation of land allocation in Dogon Gao Awakas and Banizoumbou.

A second level of analysis lies in the linkage between land holdings and relationships with the local authority (family linkages). As presented earlier, primary land holders in the traditional land tenure system are descendants of the founding family and were not traditionally subjected to tithe payment, while secondary right holders (or use-right holders) are descendants of the families that accompanied the founding family and were subjected to tithe payment. These two groups may be considered as having a secure tenure over their land. Finally all other family are considered as tenant and are, therefore, subjected to tithe payment and tenure uncertainty. Table VI.2 presents the linkages between type of tenure, land holdings and family ties to "founding families" for the sub-samples for which land holding is quantified.

Table VI.2: Average size of land holdings in Banizoumbou and in Dogon Gao Awakas

	Banizoumbou	Dogon Gao Awakas
Average land holdings (N=20) (ha)	6.7	11.9
Average land holdings for the village chief and his entourage (N= 6 in Banizoumbou and N= 7 for Dogon Gao Awakas) (ha)	9.8	14.7
Average land holdings for households not being a household of the village chief or his entourage (N= 14 in Banizoumbou and N= 13 for Dogon Gao Awakas) (ha)	3.3	10.8

Note: the small size of these sub-samples did not allow for formal statistical testing

Table VI.2 reveals that the land holdings of primary and secondary right holders are bigger than land holdings of tenants. This again points to the fact that the traditional local land tenure system still holds and is still defined by family relationships.

This leads to a first conclusion. Traditional land tenure in the villages of Banizoumbou and Dogon Gao Awakas can still be considered the form of land tenure that dominates. This has two major consequences: (1) despite the aforementioned stress that it undergoes, the traditional land tenure system is still governing land use and appropriation; and (2) family relationships still form the matrix which defines tenure relationships.

Traditional authority

The core of traditional authority lies in the village chief and his entourage. When analyzing communication patterns, the approach used here allows a comparison of the relative importance of the village chief and his entourage. Table VI.3 shows that the village chief is mentioned more often than any other individual in the sample (390 times out of 5040 for Dogon Gao Awakas and 126 times out of 2711 times for Banizoumbou).

Table VI.3: Relative importance of the village chief and of the group formed by the village chief and its entourage in terms of communication for Banizoumbou and Dogon Gao Awakas.

	Banizoumbou		Dogon Gao Awakas	
	Number	Percentage of total	Number	Percentage of total
Number of households surveyed	74	54	56	46
Total number of names generated within the community	2711(*)	100	5040	100
Village chief	1	1.3	1	1.8
Occurrence of the name of the village chief	129	4.8	390	7.7
Village chief plus his entourage	11	14.9	10	17.9
Occurrence of the names of the village chief and his entourage	550	20.3	1800	35.7

* This number is quite small when compared with the possible maximum of 5772 names (number of subjects times the number of name generators). In Banizoumbou, most interviewees did not give a second or a third name and some gave names outside of the community.

Furthermore, when considering the group formed by the village chief and his entourage, the names of these group members are mentioned in Banizoumbou 50 times on average while the average for all the members of the sample is 36.6. In Dogon Gao Awakas, these numbers are 180 and 90. These results indicate that the village chiefs and their entourages are important persons in terms of communication. This shows that traditional authority has an impact in the communication patterns and, as such, is still an institution that has an important role in defining social relations.

Family

In Dogon Gao Awakas, 68% of the names that were generated (3427 names out of 5040) were the names of close family members (i.e., father, older maternal uncles, who is identified as having the role of surrogate father if the father deceases, brothers and older son of the older maternal uncle). In Banizoumbou, 57% of the names that were generated were the names of close family members. When considering only the names generated that are those of community members (i.e., excluding names of persons not from the village), 86% of the names were those of close family members.

These results demonstrate that the family as an institution is important in explaining communication patterns within these two villages. This confirms the results regarding stratification, tenure, and traditional authority as these two institutions are shaped by

kinship. The combination of the results regarding land tenure, traditional authority and family shows that kinship can be understood as a matrix of social relations, a matrix that shapes, among other things, tenure relationships and power.

Transhumance contracts

Table VI.4 shows that transhumance contracts are relatively frequent among households raising cattle and/or sheep. These contracts are established on the basis of mutual trust (i.e., the livestock owner entrust his livestock to the keeper and the keeper knows that he will be paid upon return of the animal[s]).

Table VI.4.: Number of households having sheep or cattle, number of households involved in transhumance contracts for Banizoumbou and Dogon Gao Awakas.

	Banizoumbou			Dogon Gao Awakas		
	Number	Percentage of whole sample	Percentage of cattle and/or sheep owners	Number	Percentage of whole sample	Percentage of cattle and/or sheep owners
Total number of households having cattle or sheep or both	44	59	100	20	36	100
Total number of households involved in transhumance contracts	14	19	32	18	32	90

When analysing potential relationships between different households hiring the same herder, there is no clear pattern. This indicates that transhumance contracts seem to create new linkages (i.e., linkages that are not embedded in another institution) both within the agro-pastoral community and with transhumant herders.

Manure contracts

In Dogon Gao Awakas, only five households (8.9%) were involved in manure contracts, while in Banizoumbou only six households were involved (8.1%). When elaborating on the reason why the other households were not involved in manure contracts, the following reasons were given: too expensive, possession of fields where corralling contracts would not lead to increased returns, and lack of access to herders willing to engage in corralling contracts. This indicates that corralling contracts are relatively marginal in terms of communication between herders and members of agro-pastoral communities.

VI.6 Discussion

Intra-community cooperation

Communications and, consequently, social relations in Dogon Gao Awakas and

Banizoumbou are fundamentally defined by kinship. Kinship still defines land tenure and traditional power relationships. This leads to a local social structure which revolves around key individuals, namely, the village chief and his entourage. This indicates that traditional local institutions are still strong and represent an important local institution. Despite documented evidence of the erosion of local institutions elsewhere in Niger (Ngaido 1993b), these institutions are still strong and relevant social institutions. While the strength of these institutions is established, it remains to assess their relevance in order to foster intra-community cooperative dynamics for the purpose of range management. This can be achieved by analysing how these institutions contribute to the shaping of communication and the creation of a control on communications, how these institutions model power relationships, and how these institutions may contribute to learned incapacities (see above).

In terms of communication, the results presented in Table VI.3 indicate that the village chief and his entourage, by their relative weight in communication, may be able to control communication. There is, therefore, a potential for traditional authority to serve as a conflict mediating institution (or a cooperation fostering institution). This, for instance, may explain the results of Chapter IV indicating that cooperation with the objective of range management is a definite possibility in southwest agro-pastoral Niger.

Nevertheless, the results show also that traditional authority is based on a power

imbalance between the village chief and his entourage and the rest of the village's population. The village chief and his entourage have a better access to resources (i.e., larger land holdings), have a greater control on communications, and are recognized as "the" local authority. Power imbalance have been identified above as a hindrance to conflict management.

In terms of learned incapacities (see above) , land tenure and traditional authority have an important focus on agricultural land use. Rangeland is concerned inasmuch as rangeland use has an impact on agriculture. This emphasis on agriculture may become an incapacity as it prevents parties from conducting an adequate assessment of the problem underlying the conflict, or when it becomes a way to decide quickly without a complete analysis of the chosen solution. Typically in southwest agro-pastoral Niger, this may lead to an under-assessment of the benefits of keeping the pastoral space open. As demonstrated in the preceding chapters, there are definite benefits for agro-pastoralists in keeping their pastoral space accessible. This leads to the analysis of inter-community cooperation.

Inter-community cooperation

Before discussing the results in terms of inter-community cooperation it is important to clarify again what are the different communities in interaction. First, there are the agro-

pastoral communities, which in the majority have a strong historical focus on agriculture bur who have been involved in livestock raising. Second, there is the community of transhumant herders, who may be linked to an agro-pastoral community, but who belong to a group which has a strong historical focus on mobile livestock raising (pastoralists). Their differences within the scope of this chapter lies at several level. The agro-pastoral communities have authority on land within the limits of their village and their foremost priority is crop agriculture. The herders have authority on the herds (and therefore on the manure) that they are tending, their priority is livestock raising, and they have the necessary knowledge and social organization to tend livestock during transhumance. As outlined before both group may benefit from the other. Nevertheless, it has not been possible in the course of this research to identify sustained and/or widespread reciprocity relations between these two groups.

Three institutional pathways can be identified to foster cooperation between herders and agro-pastoralists. First, there are the two institutions that specifically involve exchanges between herders and agro-pastoralists, namely, transhumance contracts and manure contracts. Secondly, there is the possibility that the village chief acts as an intermediary with transhumant herders.

Using traditional authority as a mediating institution between an agro-pastoral community and transhumant herders has positive and negative aspects similar to those pertaining to

intra-community cooperation. Traditional authority may help to manage conflicts through information control. Nevertheless, in the agro-pastoral area, traditional authority has a strong positive bias toward agricultural activities. Furthermore, agriculturalists have easier access to traditional authority in the agro-pastoral area. This gives agro-pastoralists more power when they use the channel of traditional authority. These considerations indicate that traditional authority may not be an ideal mediating institution.

Manure contracts could be interesting if they were occurring more often. Nevertheless, Neef (1998) shows that manure contracts are mostly occurring between large land holders and transhumant herders. While the dataset that was built in the course of the present research does not allow a confirmation of this observation, some of the reasons advanced for not engaging in manure contracts seem to confirm Neef's observations. A first reason that was given is the cost of the manure contract. This can be directly linked to access to land (manure contracts being paid in millet). A second reason that was given was the fact that manure could not be rationally used on marginal land. Again, this is directly linked with access to the land resource base. From these observations it is possible to assume that manure contracts are linked to land tenure and, therefore, to traditional authority and kinship. These institutions have been already identified as problematic ways to foster inter-group cooperation.

Finally, transhumance contracts could be considered as an institutional pathway to foster

cooperation between agro-pastoralists and transhumant herders. These contracts have several features that may be of interest. In terms of communication, as these contracts are negotiated face-to-face, there are no possibilities of controlling the information flow. Yet these communications occur in a very particular context. There is a genuine need for mutual trust in order to have a successful transhumance contract. This may be considered as a learned capacity. Transhumance contracts seem, therefore, to be a potential avenue to develop inter-community cooperation.

The nature of transhumance contracts and their potential for fostering cooperative behaviours, gives a supplementary argument to the conclusions of Chapters IV and V. Range management in southwest agro-pastoral Niger is dependant upon the joint development of livestock raising by traditional pastoralists and by agro-pastoralists with a tradition of practising agricultural activities. The convergence of the results of Chapters IV, V, and VI leads to the conclusion of this research.

CHAPTER VII: CONCLUSION

This concluding chapter will cover different elements of the present research. First, conclusions regarding the case study itself will be presented. Secondly, conclusions in terms of CPNR management and its analysis will be covered. Thirdly, observations in terms of the process of negotiating disciplinary boundaries and the challenges that it poses will be reflected upon. Finally, areas of future research on rangeland management in Niger, CPNR management analysis, and the implementation of inter-disciplinary research, will close this dissertation.

VII.1 On rangeland management in southwest agro-pastoral Niger

The findings of this research have several potential consequences in terms of community-level rangeland management in southwest agro-pastoral Niger. The results of Chapters IV to VI will be summarized. The integration of these results will then be presented. The potential consequences of these results in terms of policy will be presented. Finally, the characteristics of property rights, risk, and livestock development in southwest agro-pastoral Niger that are presented in Chapter III will be analysed in the light of the results of the present research.

The first question is phrased as follow: what are the determinants of rangeland use in southwest agro-pastoral Niger? For this question, the results show that rangeland in southwest agro-pastoral Niger may be managed during the rainy season provided that cooperative dynamics are strong. This means that local-level rangeland management by agro-pastoralists is a definite possibility. This seems contrary to a dominant argument in the literature saying that rangeland management may very well disappear because of the transfer of livestock ownership from traditional pastoralists to other segments of the population. One must not, however, jump to the conclusion that rangeland is efficiently or sustainably managed and that, therefore, rangeland management by agro-pastoralists is sufficient. Livestock production occurs on village land during the rainy season, but this should not minimize the importance of livestock production while on transhumance. Furthermore, sending livestock away from the village land can be, in itself, a management decision (i.e., by lowering the stocking rate on the local rangeland). Mobility is, therefore, a key element in managing rangeland in southwest agro-pastoral Niger. This leads us to the second question which is phrased as follow: what are the determinants of livestock mobility in southwest agro-pastoral Niger?

The rationale for mobility does not appear from the estimation of the mobility equation. Nevertheless, community members stressed the importance of mobility for gaining access to high quality rainy season pastures. The estimation of the livestock mobility equation indicates that the principal determinant of livestock mobility is the availability of

competent herders (i.e., traditional pastoralists). This points to the major conclusion of this dissertation: livestock development among agro-pastoralists and local level range management are directly dependant on the sustained development of livestock-raising activities among traditional pastoralists. Their exclusion from pastoral activities, through the closure of the pastoral action space or through a continued transfer of livestock ownership, may render useless any attempts to develop agro-pastoral integration.

This leads to the third and fourth questions dealing with range enclosure and its reversibility. The third question reads as follows: what is the impact of rainfall shocks on rangeland property rights? The fourth question reads as follow: is the marginalization of the pastoral space is avoidable or reversible? The historical events analysis showed that range enclosure may occur by discrete jumps directly linked to the occurrence of droughts. This linkage can be explained by the fact that, after droughts with marked livestock losses, competing claims on the land allocated to rangeland by outsiders are less likely to occur. This reduces the costs (by suppressing conflict costs) of enclosing village rangeland. The historical events analysis showed as well that the closure of the pastoral space can sometimes be reversed provided that agro-pastoralists have an interest in doing so (i.e., raising livestock). Again, this points to the most important conclusion of this dissertation: livestock development can be achieved through local-level rangeland management provided that both agro-pastoralists and pastoralists are seen in terms of complementarity rather than in terms of opposition. Healthy herds owned and managed

by both groups are the best guarantee of keeping the pastoral space open. Nevertheless, keeping the pastoral space open entails that communities must be able (1) to cooperate among themselves in order to manage their rangeland and (2) to cooperate with outsiders in order to manage their rangeland.

This leads to the last hypothesis to be tested: traditional local institutions have the capacity to play a role in the management of rangeland. The importance of existing local institutions and their ability to be conductive to range management in southwest agro-pastoral Niger can be divided into two dimensions. First, members of a community have to cooperate in order to manage their village rangeland. Second, members of a community have to be able to cooperate with outsiders.

Concerning the first dimension, the analysis of local communication networks shows that family institutions, local power institutions and property rights structure are still extremely important in shaping village level social relations. Nevertheless, these structures are very central (i.e., a small number of individuals concentrate power, land holdings being a function of their closeness with the village head person and his direct entourage). This means that, while traditional local institutions are still strongly established, they may not, because of their centrality, be conducive to cooperation.

When considering the second dimension, cooperation with outsiders, transhumance

contracts, and manure contracts show different characteristics. Manure contracts are modelled after property relations (i.e., the bigger the land holding, the higher the probability of engaging in manure contracts) and, therefore, establishing a "strong link" with pastoralists. Furthermore, manure contracts are clearly the exception rather than the norm. Transhumance contracts, on the contrary, are established between pastoralists and central individuals as well as between non-central individuals and pastoralists. It seems, therefore, that the communication link between pastoralists and agro-pastoralists that would be the most supportive of inter-community cooperation would be transhumance contracts. Again, this points to the fact that both groups need to interact and that pastoral activities seem to be a better route for these interactions than any other identified in the course of this research.

To summarize the different results that were obtained in the course of this research, one can say that: (1) community-level rangeland management in southwest agro-pastoral Niger is a definite possibility; (2) exclusion of outsiders by community members should not be considered as a preferred route to implement this management; and (3) a potentially promising route toward community-level range management passes through the joint development of pastoral practices for agro-pastoral and pastoral populations.

These findings have several consequences in terms of policy and development intervention. First, any policy that leads to an exclusion of transhumant herders

jeopardizes livestock raising in southwest agro-pastoral Niger. Secondly, any community-level natural resource management project, program, or policy must be established while keeping in mind that there may be several user groups on the range resource and that these users may be important when considering the agro-pastoral production system as a whole. Finally, any policy, program, or project geared at reducing range-use conflicts should try to put an emphasis on a user-based conflict resolution mechanism rather than by putting in place conflict resolution schemes that are modelled on traditional power relationships.

When reviewing the developments presented in Chapter III, the results of this research bring the following contributions. In terms of the rainfall variability-mobility-tenure linkages in Niger, these results shed a particular light on the issue. While a clear theoretical link seems to exist, i.e., mobility is an *ex post* risk management strategy and common pool rangeland allows for this mobility to occur, the situation in southwest agro-pastoral Niger is more complex. Livestock mobility is more than a risk management strategy *stricto sensu*. This research shows that livestock mobility may be a risk management strategy, but that it is a mechanism by which access to better pastures is obtained as well. Mobility is directly a function of the availability of competent herders. Moreover, livestock mobility and its social organisation (transhumance contracts) may be central for the purpose of range management in southwest agro-pastoral Niger. While the importance of livestock mobility has been highlighted, the linkage between rainfall

variability and tenure is dual in nature. Theoretically, the pastoral space must remain open in order to manage rainfall risk. Empirically, this research shows that major rainfall deficits have as consequence that the pastoral space is more and more closed. Climate is, therefore, putting a stress on the rangeland tenure institution.

On the other hand, changing politics, identified as a source of stress in Section III.2, does not seem to be jeopardizing local institutions. This result is important for the implementation of the *Code Rural* that calls for a greater role of local communities in the management of their resources. Nevertheless, rangeland management may be controlled by communities, but by communities of users rather than by communities of agro-pastoral users only.

When considering livestock raising (see Section III.3) in Niger, this research shows that the two challenges that were identified – marginalization and closure of the pastoral space and transfer of livestock ownership – are intimately intertwined. The marginalization and the closure of the pastoral space may be seen as the result of a decreasing importance of traditional pastoralists following droughts. They may also be seen as an inability by agro-pastoralists to reconstruct their village-level herds.

Community-level range management in Niger is a definite possibility. Livestock mobility lies at the core of this management. Livestock mobility is, nevertheless, under stress and

there is a need to take into account the pastoral interests of both agro-pastoralists and transhumant herders in order for mobility to continue playing its central role. There lies the biggest challenge for livestock raising in southwest agro-pastoral Niger.

VII.2 On CPNR analysis

As demonstrated in Chapter II, the analysis of CPNRs leads to conclusions that are directly linked with the disciplinary framework that is used. This points to the fact that this analysis must be undertaken by crossing disciplinary boundaries. The case study presented here is an attempt at implementing an interdisciplinary approach to the conceptualisation of CPNRs. It is, therefore, important to reflect here on how and why disciplinary boundaries were crossed in the present research.

As noted earlier, property rights institutions have a dual mediating nature. First, these institutions mediate the relationship between humans and the resource (Schlager and Ostrom 1992). Second, property rights institutions mediate the relationship between humans (Lynch and Alcorn 1994). The analysis of CPNRs being the analysis of a particular form of property rights on a resource, it can be understood in terms of this dual mediating nature. This implies that the natural resource under scrutiny must be well understood (using the "tools" of ecology) as well as the social relations existing among

the user group(s) (using the "tools" of sociolgy). Finally, the interest in CPNRs lies in their exploitation for economic purposes; their analysis calls, therefore, for the use of the "tools" of economics. Consequently, in the present case study several disciplinary boundaries were crossed. These boundary-crossing or interdisciplinary dialogues are presented here.

The nature-human mediating aspect of CPNRs has been approached in the econometric analysis and in the event chronology analysis. In the econometric analysis, ecological data (i.e., rainfall and range quality) have been integrated into a game theoretical framework. This integration is first achieved theoretically in the structural equations; then ecological data are fed into the estimation of the reduced form equations. This first boundary crossing is fundamental because it establishes that property rights on the rangeland in southwest agro-pastoral Niger are directly linked with rainfall variability. Without taking this linkage into account, there is a definite risk that a rationale for the existence of CPNRs might be missed, thus leading to incorrect results and conclusions. On the other hand, the definition of range quality indices allowed the taking into account of a key natural input for the production of livestock. This is fundamental as a recognition that decisions regarding rangeland management by agro-pastoralists may be based on a genuine understanding of the resource that is used. Again, analysing rangeland management without taking into account this key information could lead to incorrect results and conclusions. This indicates that the economic analysis of natural

resource management without a systematic integration of the characteristics of the resource that is used may be misleading at best.

When reviewing the results presented in Chapter II, several elements need to be stressed here. The econometric model that is developed addresses some of the limitations of the neoclassical paradigm. While agents, in the course of this research, are modelled as optimizers, the use of a cooperative game theoretical framework allows for the taking into account of cooperative behaviours. Furthermore, as outlined above, some of the characteristics of the ecological environment are integrated in the model, thus extending the set of information that is attributed to those agents' decision making process. This is also achieved through the integration of spatial variables (e.g., distances as proxies for costs). Because of these characteristics, the econometric model that is developed here may be seen, in a Kuhnian (Kuhn 1996) framework, as a form of internalisation of "anomalies" to the neoclassical paradigm. While this allowed the testing of key hypotheses in the course of the present work, it is not sufficient to account for CPNR analysis in its complexity.

In the event chronology, resource-human interactions are taken into account differently. The focus of the event chronology is on important resource deficits and their social consequences on rangeland property rights. The approach used in the event analysis may be qualified as an non-disciplinary approach. By using this approach, it is possible to lift

some key restrictions on the analysis of CPNRs both in Niger and with reference to the analysis of CPNRs in general. First, as in the case for southwest agro-pastoral Niger, the historical embededness of institutions may be difficult to take into account quantitatively due to a lack of reliable time series data. This illustrates that the crossing of disciplinary boundaries involves also a dialogue between methodological approaches. By using event analysis, the researcher is able to address the lack of quantitative chronological data by using a rigorous qualitative approach. Secondly, by erasing disciplinary *a priori*, this approach gives to the researcher an particular insight on CPNR management. In the case study that is used here, this approach allows a questioning of key dominant assumptions regarding pastoral space closure (i.e., continuity and irreversibility).

The human-human mediating nature of property rights institutions has been analysed essentially in the network analysis. This allowed to address some key issues concerning CPNR management. It allowed a systematic assessment of the capacity of local institutions to foster intra- and inter-community cooperation for the purpose of rangeland management.

Finally, by integrating the results of the different approaches, key results in terms of policy are identified. Without using this interdisciplinary approach, it is possible to reach conclusions in terms of policy that would lead to new "tragedies" of the common. For instance, by focussing only on the first econometric approach, i.e., the testing of the

management hypothesis, it would be possible to jump to the conclusion that rangeland privatization will increase its management. In the light of the research, it would lead to an exclusion of key players, i.e., transhumant herders. This case study demonstrates that analysing CPNRs through narrowly-defined disciplinary "lenses" does not allow for an understanding of CPNR institutions, the rationale for their existence, and ways to implement their management. It must be clear however that the approach that is presented here is "an" interdisciplinary approach to CPNRs and that it is possible to envision interdisciplinarity in a multitude of ways.

The case study shows that CPNR analysis must be an interdisciplinary undertaking. This shields the researcher from disciplinary preconceptions that could lead to conclusions influenced by a disciplinary paradigm rather than by the nature of the CPNR that is the subject of this research. By freeing oneself from these preconceptions, the researcher avoids the pitfall of universalism (i.e., there is for CPNR management one institutional design that fits all CPNRs) (Breton 2000).

VII.3 On the negotiation of disciplinary boundaries

In the course of this research, the negotiation of disciplinary boundaries has been a constant issue. This section will try to cover the challenge faced when crossing

disciplinary boundaries and the ways that were used to address these challenges. Specific references will be made to the present research.

A first challenge lies in choosing the disciplines that are relevant to the problem at hand. This is deeply influenced by the disciplinary background of the researcher involved. For the author, this meant that applied tropical agro-ecology (e.g., Arrignon 1987) and econometrics applied to natural resource management (e.g., Vanderlinden 1996) are "natural" choices. Once this is posited, the researcher has to integrate the question at hand to his/her areas of expertise. In the present research, it is safe to argue that Chapter IV is the result of the integration of the research theme to the disciplinary background of the researcher. Following this integration, it is necessary to identify disciplines or approaches that will allow the researcher to transcend his disciplinary preconceptions. In the course of this research, this identification was facilitated by the development of key hypotheses, that could not be tested with either an econometric approach, or tropical agro-ecology. The nature of these hypotheses (i.e., regarding the impact of droughts and regarding cooperation) led to the identification (Chapter V) or to the development (Chapter VI) of suitable approaches. This leads to the conclusion that interdisciplinarity is supported through a focus on the research question rather then through a focus on the disciplinary background of the researcher. Once the disciplinary frameworks are chosen, the implementation of the research can proceed.

The second challenge lies in conducting research where data are collected on issues that are diverse and cross traditional conceptual, disciplinary, and methodological boundaries. In order to address this challenge, time spent in the field was of paramount importance. Time spent in the field had three definite impacts. First, it allowed the building of a relationship that allowed for the collection of quantitative and qualitative data conducted on the basis of mutual understanding and trust between investigators and subjects. Second, it allowed an immersion of the researcher in the socio-agro-ecological system under scrutiny. Finally, it led to a deeper respect for the complexity, the human importance, and environmental importance of the research question. Again, it is the focus on the research theme that allowed for a crossing of disciplinary boundaries.

The third challenge lies in the data analysis and the presentation of the results. In a disciplinary framework, each approach that is presented in this work would warrant a separate research project by itself. When presenting the results the temptation is, therefore, strong to present research results in a disjointed fashion putting the emphasis on the contribution of the research to the discipline. Again, keeping a clear focus on the research allowed for the presentation of the results in an interdisciplinary fashion.

Finally, an ongoing challenge lies, for the researcher, in identifying how the linkages between the research results and the research theme may be increased. This challenge, which poses questions regarding the researcher's identity in an academic context,

transcends largely the purpose of this research work.

VII.4. Future areas of research

When considering the case study itself, the present research has opened important avenues that could be explored. A first avenue of research that will be fundamental in terms of community level rangeland management in southwest agro-pastoral Niger lies in the analysis of how the Nigerien state and international aid agencies will be ready to envision the development of agro-pastoral communities in terms of complementarity with transhumant herders. The key result is that rangeland use in Niger and its management will only be possible if the needs of all user groups are taken into account. A second avenue of research consists of the extension of this research to other areas of Niger where pastoral groups are more important and where interactions are more conflictual. Finally, a carefully quantified analysis of the benefits of mobility may help in pursuing the objective of keeping the pastoral space open.

When considering CPNR analysis, the present case study did yield key results. It illustrates that approaching CPNR through a disciplinary lense is risky at best. Furthermore, it demonstrates that the key to CPNR management may lie in user-based collective action rather than by controlling the access to the resource. Nevertheless, the

analysis of user-based collective action has to be rooted in its natural, social, and economic contexts. As mediating institutions having a dual nature, CPNR institutions have to be approached through the analysis of the mediated issues (i.e., natural resource, human-nature interactions, social relations, and economic relations). A fundamental future area of enquiry will involve analysing how paradigmatic preconceptions led to "tragedies of the commons" and how the building of interdisciplinary analysis in all its complexity may translate itself in CPNR policies that address natural, social, and economic sustainability.

Finally, the dynamic of interdisciplinary research itself as an area of enquiry must be explored further. This could be achieved at two levels. First, the interdisciplinary research team could be a subject of enquiry. Some key questions to explore are interdisciplinary communication, power relationships among a research team as a function of the disciplinary origin, the integration of qualitative and quantitative approaches, and the building of common frames of reference. Second, the individual interdisciplinary researcher could become the subject of research on identity in the scientific community. For the author, this issue manifested itself in the existence of multiple identities, generally construed as mutually exclusive. In the course of this research, the author was presented by his colleagues as an ecologist, an environmentalist, an economist, a geographer, and a sociologist. While flattering indeed in terms of diversity of expertise, these nouns were never correct. The major argument behind this

research is that interdisciplinarity may be built through a focus on the research theme rather than on the disciplinary background. For the time of this research the author was, therefore, a CPNRist.

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Appendix 1: Survey tools for the community survey (English translation is provided in Appendix 7).

1.1 Interview framework/data collection sheet, community-level socio-economic data.

Enquête au niveau des communautés: questionnaire à l'attention du chef de village;

Département _____ Ss préfecture: _____
Canton: _____ Village: _____
Longitude: _____ Latitude: _____
Enquêteur: _____ Date: _____

A.: ***Historique:***

A.a.: Age du village dans ce lieu-ci:_____

A.b.: Date de la prise de fonction du chef actuel:_____

A.c.: Année pour laquelle des terres ont été cédées à des nouveaux venus la dernière fois:____

B.: ***Démographie***

B.a.: Nombre total de ménage:_____

B.b.: Langue parlée dans le village en majorité:_____

B.c.: Autre langue parlées: _____ _____

B.d.: Ethnie majoritaire: _____

B.e.: Autres Ethnie: _____ Nombre de ménages:_____
_____ Nombre de ménages:_____

B.f. Y-at'il des hameaux dépendant de ce village? Oui Non
Si oui combien?_____ Sont-ils d'une autre ethnie? Oui Non

B.g. Y-a-t'il des habitants du village vivant dans leur champs de façon permanente? Oui Non
Si oui sont ils d'une autre ethnie? Oui Non _____

B.h.: Nombre d'individus extérieurs au village exploitant une parcelle sur les terres du village:_ Préciser d'où viennent ces agriculteurs et quelle est leur origine ethnique.

_____
_____

B.i.: Nombre de chefs de ménages migrant saisonnier pour:
1. Cette année _____
2. L'année passée _____

L'an passé quelle a été la période de départ?:_____

L'an passé quelles ont été les

destinations:_____

C.: ***État des terres***

C.a.: L'an passé, combien de bottes de mil a pu avoir un ménage

au maximum ____ au minimum ____ En moyenne _____

C.b.: Importance des croûtes indurées (glacis, gangani):

Elles sont de :

Plus de 3/4 des terres du village? ❑;

Plus de la moitié des terres du villages? ❑;

Moins de la moitié des terres du village? ❑;

Moins du quart des terres du village ? ❑

C.c.: Globalement les pâturages sont bons ❑, /moyens ❑, /mauvais ❑.

_____

_____

POUR L'AN PASSÉ

C.d.: Que font-ils avec les résidus du Niebe? Ils récolte, Ils vendent, Ils s'en servent pour leur bétail_____

Stockent-ils les résidus du mil pour le bétail Oui Non

Si ils récoltent, quelle proprotion est reste dans les champs?: Plus de 3/4 ❑

Plus de la moitié ❑ Moins de la moitié ❑

Y a t-il un contrôle de l'accès aux résidus dans les champs? Oui ❑ Non ❑

Si oui expliquer_____

C.e. L'an passé Quand le bétail a-t-il commencé à pâturer les résidus (seulement les résidus!!!) laissés dans les champs?_____ Quand ont-ils cessé?_____

L'an passé Quand le bétail a-t-il commencé à manger les résidus récoltés?_____ Quand ont-ils cessé?_____

C.f. Utilisent-ils du fumier sur leurs champs Oui Non

Si oui quelle proportion des chefs de ménage en utilisent-ils L'AN PASSÉ?

Tous ❑ Plus de 3/4 ❑ Plus de la moitié ❑

Moins de la moitié ❑ Moins du quart ❑

Font-ils des contrats pour la fumure de leur champs? Oui Non

Si oui quelle proportion des chefs de ménage font ces contrats?L'AN PASSÉ

Tous ❑ Plus de 3/4 ❑ Plus de la moitié ❑

Moins de la moitié ❑ Moins du quart ❑

Si oui avec quels pasteurs (transhumants, voisins, du village même)

D. Bétail

D.a.: Nombre de ménage n'ayant pas de:

Bovins: _____ Ovins: _____ Caprins: _____

D.b.: Nombre de ménages ayant des: (séparer par quartier pour les villages importants)

type de bétail	Nombre de ménage	Plus grand troupeau	Taille moyenne	Nombre total de têtes pour le village
Quartier 1:				
Bovins:				
Caprins:				
Ovins:				
Quartier 2:				
Bovins:				
Caprins:				
Ovins:				
Quartier 3:				
Bovins:				
Caprins:				
Ovins:				

D.c.: Y-a-t-il plusieurs troupeaux? Oui ❑ Non ❑ si oui combien? _____

D.d.: L'an passé qui a gardé les troupeaux? En saison sèche _____

En saison des pluies _____

D.e.: Les troupeaux du village partent-ils en transhumance? Oui ❑ Non ❑

Si oui préciser pour chaque troupeau et pour cette année si les bergers sont des

membres de la famille ou bien des bergers professionnels:
Quelle proportion du bétail du village est-il pris en charge par des bergers professionnel?_____
Nombre de troupeau pris en charge par des professionnels: _____
Préciser pour ses troupeaux:

	Mois départ	Mois de retour	Destination	Nombre de tête
Troupeau 1				
Troupeau 2				
Troupeau 3				
Troupeau 4				
Troupeau 5				

Nombre de troupeau pris en charge par les ménages eux même: _____
Préciser pour ses troupeaux (si possible):

	Mois départ	Mois de retour	Destination	Nombre de tête
Troupeau 1				
Troupeau 2				
Troupeau 3				
Troupeau 4				
Troupeau 5				

D.f. Combien de bovins **ne partent pas** en transhumance ?
Tous ❑ Plus de 3/4 ❑ Plus de la moitié ❑
Moins de la moitié ❑ Moins du quart ❑
Combien de ovins **ne partent pas** en transhumance ?
Tous ❑ Plus de 3/4 ❑ Plus de la moitié ❑
Moins de la moitié ❑ Moins du quart ❑
Combien de caprins **ne partent pas** en transhumance ?
Tous ❑ Plus de 3/4 ❑ Plus de la moitié ❑
Moins de la moitié ❑ Moins du quart ❑

D.g.: Y-a-t-il des têtes de bétail appartenant à d'autres communautés **voisines** parttageant un pâturage de la communauté? Oui ❑ Non ❑
Si oui combien environ de chaque especes et nommer la communauté d'origine si

connue?

Communauté d'origine	Bovins	Ovins	Caprins	Quand viennent-ils et pour combien de temps

D.h. Description des transhumants passant sur le terroir villageois. POUR L'AN PASSÉ

D'où viennent-ils?_____

_____

_____

Par rapport au troupeau du village les troupeaux transhumants sont de quelles tailles?

_____

_____

_____Combien de temps en moyenne restent-ils_____

_____

Quand arrivent-ils_____ Quand quittent ils_____

E Action collective

E.a. Action en groupe

Existe-t-il des: Groupe d'échange de travail (bogou/gayya) Oui ❑ Non ❑

Groupement coopératif Oui ❑ Non ❑

Autre groupement Oui ❑ Non ❑

Préciser_____

Pour chaque groupe préciser le pourcentage 3/4, 1/2, 1/4 de la population participant au groupement ceci pour par exemple

Groupements féminins _____ Tontines _____ Greniers _____

_____ _____ _____

_____

E.b.: Organisation de la vie religieuse

État de la mosquée: Usée ❑, /moyen ❑, /neuf ❑, /tout à fait neuf ❑, /pas de mosquée ❑. Mosquée entretenue par?_____

_____

Existe-t-il à travers la mosquée un mécanisme de soutien aux plus démunis?

Oui ❑ Non ❑

Si oui, comment fonctionne-t-il?_____

_____

_____

E.c.: Gestion des conflits

Combien y-a-t-il eu de conflits durant les 5 dernières années? Entre

Agriculteur-agriculteurs_____

Agriculteurs-pasteurs_____

Pasteurs-pasteurs_____

Pour chaque conflit de l'année précédente demander une description de la façon dont cela s'est passé en insistant sur les acteurs ayant intervenus et sur le caractère répétitif ou non du conflit en question.

Conflit 1:Description résumée_____

Conflit entre: Agriculteur-agriculteurs ❑ Agriculteurs-pasteurs ❑ Pasteurs-pasteur ❑

Conflit : Neuf ❑, Ancien ❑ Répétitif ❑

Réglé définitivement ? Oui ❑ Non ❑

Liste des agents impliqués au niveau du conflit et de sa résolution: (préciser la fonction officielle ou sociale, le rôle dans le conflit)

1. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____

Conflit 2:Description résumée_____

Conflit entre: Agriculteur-agriculteurs ❑ Agriculteurs-pasteurs ❑ Pasteurs-pasteur ❑

Conflit : Neuf ❑, Ancien ❑ Répétitif ❑

Réglé définitivement ? Oui ❑ Non ❑

Liste des agents impliqués au niveau du conflit et de sa résolution: (préciser la fonction officielle ou sociale, le rôle dans le conflit)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

F.*: *Intégration: aspect matériels et géographique

***F.a.*:** Où les membres de la communauté achètent-ils les produits de première nécessité (sel, savon, huile, pétrole, allumette, thé, kola...)?_____
À quelle distance?_____

***F.b.*:** Où les membres de la communauté achètent-ils ou vendent-ils du grain? _____ À quelle distance? _____

F.c.: Où les membres de la communautés achètent-ils ou vendent-ils le bétail? _____ À quelle distance? _____

***F.d.*:** Où les fermiers achètent-ils et vendent-ils leur lait?_____ _____

***F.e.*:** Combien de membres de la communauté possèdent-ils des animaux de bât?__

***F.f.*:** Combien de membres de la communauté possèdent-ils une charrette pour traction animale?_____

***F.g.*:** Combien y-a-t-il de motocyclettes dans le village?_____

***F.h.*:** Combien y-a-t-il de véhicules dans le village?_____

F.i. Y-a-t'il une école? Oui Non Si oui pour enfant de quel à quel âge

F.j. Y-a-t'il des magasins? Oui Non

F.k. Y-a-t'il des téléphones, l'électricité, autres_____
_____

G. Intégration: aspect socio-politique

Discuter la relation entre le chef, et les autorités sous régionales (Chef de canton, autres chefs de village, sous préfet).être précis dans le report des questions soulevées!!!!!

POUR L'AN PASSÉ

Quelle est la fréquence des rencontres avec les chefs des villages voisins et à quelles occasions?

_____
_____

POUR L'AN PASSÉ
Quelle est la fréquence des rencontres avec le chef de canton et à quelles occasions?

POUR L'AN PASSÉ
Quelle est la fréquence des rencontres avec le sous préfet et à quelles occasions?

I.2 Interview framework/data collection sheet for the participatory mapping

Questionaire accompagnant l'exercice de cartographie communautaire

Village de _____

Identification des éléments suivants lors de l'exercice de cartographie proprement dit

Lieux de l'entrevue, localisation des différents hameaux dépendant du village
Localisation des points d'eau, distinction entre puit traditionel, puit cimenté, forage et mare. Noter la permanence des points d'eau
Emplacement des terres de cultures et des jachères
Emplacement des pâturages de saison pluvieuse et de saison sèche
Emplacement des boisés
Emplacement des couloirs de passage, noter qui en sont les utilisateurs
Identification des villages voisins
Identification des frontières apparentes

Pendant l'exercice réponse aux questions suivantes

Points d'eau

Combien de points d'eau de différents types sont-ils disponibles
Toute l'année: Mare___ Puits traditionnel___ Puits moderne___ Forage____
De façon saisonnière Mare_____ Puits traditionnel____ Puits moderne_____
Quelles sont les règles gouvernant l'utilisation de ces points d'eau

_____

_____

Ces règles sont brisées? Combien de fois l'année précédente?_____
Y-a-t-il des individus qui ont été punis? Oui ❑ Non ❑
Si oui combien?_____
Comment le bétail accède-t-il à ces points d'eau? En saison des pluies_____

_____

En saison sèche_____

_____

Y-a-t-il des conditions d'accès? Fixé par qui? Expliquer en détail pour chaque point d'eau:_____

_____

_____

Y-a-t-il un ordre d'utilisation? Expliquer en détail pour chaque point d'eau.

_____
_____
_____
_____

Pâturages

Existe-t-il des pâturages communs:
En saison des pluies Oui ❑ Non ❑
En saison sèche Oui ❑ Non ❑
Description des pâturages
De saison des pluies_____
_____
De saison sèche_____
_____
_____
_____
_____
Accès aux pâturages
En saison des pluies_____
_____
_____
En saison sèche_____
_____
_____
_____
_____

Quelles sont les règles gouvernant l'utilisation de ces pâtures?_____
_____
Ces règles sont brisées? Combien de fois l'année précédente?_____
Y-a-t-il des individus qui ont été punis? Oui ❑ Non ❑
Si oui combien?_____
Compléter les éléments suivants pour chaque pâturage
Pâturage 1 Saison des pluies Saison sèche
Date de mise en commun:_____ Utilisation avant la mise en pâture: _____
_____
Conditions d'accès pour les membres du village:_____
_____
Condition d'accès pour le bétail provenant de l'extérieur du village _____
_____
Y-a-t-il un mécanisme de fixation du nombre maximal de têtes de bétail?
Oui ❑ Non ❑

Si oui expliquer en détail:_____

_____

Y-a-t-il un mécanisme de fixation de la période à laquelle le bétail peut utiliser la pâture? Oui ❑ Non ❑

Si oui expliquer en détail:_____

_____

qui prend les décisions en ce qui a trait à l'utilisation de la pâture?_____

_____

Pâturage 2 Saison des pluies Saison sèche

Date de mise en commun:_____ Utilisation avant la mise en pâture: _____

_____

Conditions d'accès pour les membres du village:_____

Condition d'accès pour le bétail provenant de l'extérieur du village

_____

Y-a-t-il un mécanisme de fixation du nombre maximal de têtes de bétail?

Oui ❑ Non ❑

Si oui expliquer en détail:_____

_____

_____

Y-a-t-il un mécanisme de fixation de la période à laquelle le bétail peut utiliser la pâture?

Oui ❑ Non ❑

Si oui expliquer en détail:_____

qui prend les décisions en ce qui a trait à l'utilisation de la pâture?_____

Couloirs de passage

Combien de couloirs de passage passent par les terres du village? _____

Quelle est leur origine

	Année de début d'existence	Origine de la création du couloir	Utilisateurs
Couloir 1		_____ _____	_____ _____
Couloir 2		_____ _____	_____ _____

Couloir 3			
Couloir 4			

Quelles sont les règles gouvernant l'utilisation de ces couloirs?_____
_____
_____
Ces règles sont brisées? Combien de fois l'année précédente?_____
Y-a-t-il des individus qui ont été punis? Oui ❑ Non ❑
Si oui combien?_____
Le bétail qui emprunte les couloirs de passage mangent ils dans les champs en bordure?
Souvent ❑ Rarement ❑ Jamais ❑
Décrire ce qui se passe lorsque le bétail divague dans les champs sans permission.
_____
_____

I.3. Interview framework/data collection sheet, livestock management practice

Durant **la saison sèche qui vient de se terminer** y-a-t-il eu des bovins qui ont été volé sur le terroir du village? Oui Non
Si Oui Combien?_____
Durant la saison sèche qui vient de se terminer y-a-t-il eu des bovins qui sont mort sur le terroir du village? Oui Non
Si Oui Combien?_____ Si oui combien ont été égorgés?_____
Durant **la saison sèche qui vient de se terminer** y-a-t-il eu des bovins qui sont parti en transhumance? Oui Non
Si oui:
Durant la saison sèche qui vient de se terminer y-a-t-il eu des bovins qui ont été volé durant les transhumances? Oui Non
Si Oui Combien?_____
Durant la saison sèche qui vient de se terminer y-a-t-il eu des bovins qui sont mort en transhumance? Oui Non
Si Oui Combien?_____ Si oui combien ont été égorgés?_____
COMMENTAIRES:
_____
_____
_____

Durant **la saison des pluies précédente** y-a-t-il eu des bovins qui ont été volé sur le terroir du village? Oui Non
Si Oui Combien?_____
Durant **la saison des pluies précédente** y-a-t-il eu des bovins qui sont mort sur le terroir du village? Oui Non
Si Oui Combien?_____ Si oui combien ont été égorgés?_____
Durant **la saison des pluies précédente** y-a-t-il eu des bovins qui sont parti en transhumance? Oui Non
Si oui:
Durant **la saison des pluies précédente** y-a-t-il eu des bovins qui ont été volé durant les transhumances? Oui Non
Si Oui Combien?_____
Durant **la saison des pluies précédente** y-a-t-il eu des bovins qui sont mort en transhumance? Oui Non
Si Oui Combien?_____ Si oui combien ont été égorgés?_____
COMMENTAIRES:

_____
_____
_____

Si les bovins ne partent pas en transumance de saison des pluies demander pourquoi:

_____
_____
_____
_____
_____

Si les bovins sont partis en transhumance durant une des saison demander les questions suivantes pour chaque saison
Saison des pluies:
Qui emmène le bétail en transhumance?_____
Quels sont les arrangement (combien paient-ils et quand?)

_____
_____
_____
_____
_____Saison sèche:
Qui emmène le bétail en transhumance?_____
Quels sont les arrangement (combien paient-ils et quand?)

_____
_____
_____

Date:_____
Marché:_____
Animal numéro:____

Clef de détermination

Il faut utiliser cette clef dichotomique systématiquement avant de consulter les photos.

1. **Au moins six paires de côtes sont visibles**
2. **Les épyphises sont visibles**
3. **L'individu est clairement au bord de la mort**
4. **La masse musculaire entre le Tuber Coxae et le tuber ischii est fortement convexe**
5. **Les tuber coxae sont visibles**
6. **Couverture de graisse sur les vertèbres caudales**

Oui —2	Non—5
Oui —3	Non—M-
Oui—L-	Non—4
Oui —L	Non—L+
Oui—M	Non—6
Oui—F	Non—M+

Entourer la réponse à chaque question ainsi que la marque finale

Type d'acheteur:_____

Sexe de l'animal: M F

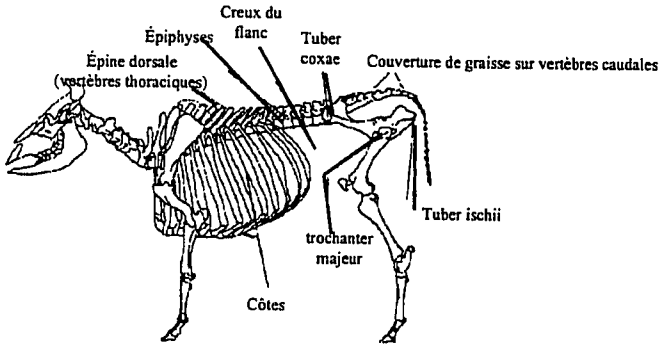
Age de l'animal:____

Tour de cage thoracique:_____

Hauteur de l'animal:____

Longueur de l'animal:_____

Prix de l'animal:_____



Adapté de Nicholson et Butterworth, 1986

I.4. Scoring card and data collection sheet, cattle price survey

I.5. Data aggregation sheet, cattle price survey

Projet Droit de Propriété Risque et Développement de l'Élevage
Feuille de relevé des prix sur le marché pour **Bovins** à remplir le soir apres chaque journée en se basant sur les fiches individuelles
Enquêteur_____ Date_____
Marché_____

Numéro	Sexe	Longueur	Hauteur	Tour du thorax	Marque	Prix	Acheteur, Commerçant ou particulier	commentaires

Remarques:_____

I.6. Data collection sheet, sheep price survey

Projet Droit de Propriété Risque et Développement de l'Élevage

Feuille de relevé des prix sur le marché pour **Ovins**

Enquêteur_____ Date_____

Marché_____

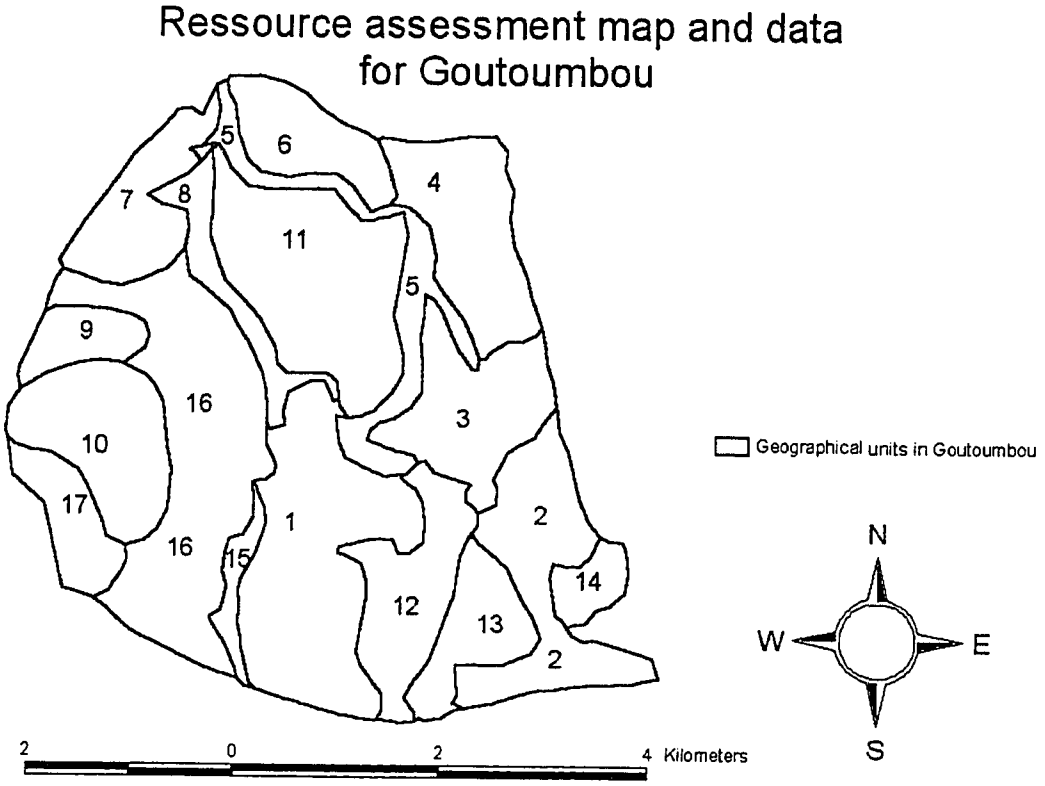
Nu-mero	Sexe	Longueur	Hauteur	Poids	Prix	Acheteur , Commerçant ou particulier	Com-mentaire/ âge

Remarques:_____

Terroir_____Date_____Établi par Jean-Paul Vanderlinden

Unité Géog	l/h/c	OcSol				Champs				Chaume				Espèce Dom. 1	Espèce Dom. 2	Espèce Dom. 3	PF%	0	1 2 5	2 5 0	5 0 0	1 0 0 0	2 0 0 0	4 0 0 0	<	Pâture				Couvert ligneux				
		S	F	J	C	B	M	H	Y	dr	co	ex	br													N	P	B	T	0	1	2	5	<

Appendix 2: Sample resource assessment map



For each unit the land use pattern was estimated (see Table A2.1). "Sterile land" is land on which nothing grew, "bushes" is land covered by bushes, "fallow land" is non sterile land and was not cultivated during the last rainy season, "cultivated land" is land that was cultivated during the last rainy season. Some units were separated into sub-units following field observation. In terms of species composition (see Table A2.2), for each unit the three dominant species (dom sp 1 to 3) were identified for the tree layer as well as for the herbaceous layer in fallows (herb.fallow) and fields (herb.field).

Table A2.1: Land use in Goutoumbou

Geographical unit	Proportion of sterile land (%)	Proportion of bushes (%)	Proportion of fallow (%)	Proportion of cultivated fields (%)
1	90		10	
2a (90%)	30		40	40
2b (10%)	40		60	
3			20	80
4a (80%)	30		40	30
4b (20%)	30		70	
5a (50%)	30		40	30
5b (50%)	40		60	
6a (80%)			40	60
6b (20%)			40	60
7	50		30	20
8		30	60	10
9	20		80	
10a (80%)		10	30	60
10b (20%)	70		30	
11			80	20
12a (80%)			60	40
12b (20%)	10		90	
13			10	90
14a (50%)			60	40
14b (50%)			60	40
15			40	60
16	30		40	30
17	80		20	

Table A2.2: Species composition (three dominant species) for the tree layer and the herbaceous layer in field and fallow, Goutoumbou village.

Geo unit	Layer	Dom sp 1	Dom sp 2	Dom sp 3
1	tree	*Boscia senegalensis*	*Combretum micranthum*	*Guiera senegalensis*
	herb. fallow	*Schoenefeldia gracilis*	*Aristida mutabilis*	*Cenchrus biflorus*
2a	tree	*Combretum micranthum*	*Boscia senegalensis*	*Guiera senegalensis*
	herb. field	*Cenchrus biflorus*	*Eragrostis tremula*	*Cassia mimosoides*
	herb. fallow	*Cenchrus biflorus*	*Aristida mutabilis*	*Aristida sieberiana*
2b	tree	*Combretum glutinosum*	*Combretum micranthum*	*Ziziphus mauritiana*
	herb. fallow	*Cenchrus biflorus*	*Andropogon gayanus*	*Eragrostis tremula*
3	tree	*Boscia senegalensis*	*Guiera senegalensis*	*Combretum glutinosum*
	herb. field	*Mitrocarpus scaber*	*Eragrostis tremula*	*Andropogon gayanus*
	herb. fallow	*Cenchrus biflorus*	*Eragrostis tremula*	*Andropogon gayanus*
4a	tree	*Guiera senegalensis*	*Boscia senegalensis*	*Combretum micranthum*
	herb. field	*Mitrocarpus scaber*	*Cenchrus biflorus*	*Eragrostis tremula*
	herb. fallow	*Cenchrus biflorus*	*Schoenefeldia gracilis*	*Eragrostis tremula*
4b	tree	*Piliostigna reticulatum*	*Boscia senegalensis*	*Combretum micranthum*
	herb. fallow	*Cenchrus biflorus*	*Andropogon gayanus*	*Cassia mimosoides*
5a	tree	*Combretum glutinosum*	*Guiera senegalensis*	*Piliostigna reticulatum*
	herb. field	*Eragrostis tremula*	*Panicum glaucum*	
	herb. fallow	*Panicum glaucum*	*Sesbania allatum*	
5b	tree	*Faidherbia albida*	*Piliostigna reticulatum*	*Ziziphus mauritiana*
	herb. fallow	*Andropogon gayanus*	*Eragrostis tremula*	*Cenchrus biflorus*
6a	tree	*Guiera senegalensis*	*Boscia senegalensis*	*Combretum micranthum*
	herb. field	*Eragrostis tremula*	*Cenchrus biflorus*	*Mitrocarpus scaber*
	herb. fallow	*Cenchrus biflorus*	*Eragrostis tremula*	*Aristida mutabilis*
6b	tree	*Combretum glutinosum*	*Piliostigna reticulatum*	*Faidherbia albida*
	herb. field	*Eragrostis tremula*	*Cenchrus biflorus*	*Mitrocarpus scaber*
	herb. fallow	*Andropogon gayanus*	*Pennisetum pedicellatum*	*Ipomoea azarifoloa*
7	tree	*Guiera senegalensis*	*Boscia senegalensis*	*Maerua crassifolia*
	herb. field	*Eragrostis tremula*	*Mitrocarpus scaber*	*Cenchrus biflorus*
	herb. fallow	*Cenchrus biflorus*	*Schoenefeldia gracilis*	*Aristida mutabilis*
8	tree	*Combretum glutinosum*	*Piliostigna reticulatum*	*Guiera senegalensis*
	herb. field	*Eragrostis tremula*	*Cenchrus biflorus*	*Mitrocarpus scaber*
	herb. fallow	*Andropogon gayanus*	*Pennisetum pedicelatum*	*Cenchrus biflorus*
9	tree	*Guiera senegalensis*	*Boscia senegalensis*	*Combretum micranthum*
	herb. fallow	*Mitrocarpus scaber*	*Cenchrus biflorus*	*Sida cordifolia*
10a	tree	*Guiera senegalensis*	*Boscia senegalensis*	*Combretum micranthum*
	herb. field	*Eragrostis tremula*	*Mitrocarpus scaber*	*Cenchrus biflorus*
	herb. fallow	*Cenchrus biflorus*	*Mitrocarpus scaber*	*Eragrostis tremula*
10b	tree	*Piliostigna reticulatum*	*Combretum glutinosum*	*Guiera senegalensis*
	herb. fallow	*Panicum glaucum*	*Pennisetum pedicellatum*	*Eragrostis tremula*
11	tree	*Guiera senegalensis*	*Combretum glutinosum*	*Maerua crassifolia*
	herb. field	*Eragrostis tremula*	*Mitrocarpus scaber*	*Cenchrus biflorus*
	herb. fallow	*Eragrostis tremula*	*Mitrocarpus scaber*	*Cenchrus biflorus*

Table A2.2 (part 2): Species composition (three dominant species) for the tree layer and the herbaceous layer in field and fallow, Goutoumbou village.

Geo unit	Layer	Sp dom 1	Sp dom 2	Sp dom 3
12a	tree	*Boscia senegalensis*	*Combretum glutinosum*	*Maerua crassifolia*
	herb. field	*Eragrostis tremula*	*Mitrocarpus scaber*	*Cenchrus biflorus*
	herb. fallow	*Cenchrus biflorus*	*Chrosophora senegalensis*	*Eragrostis tremula*
12b	tree	*Faidherbia albida*	*Piliostigna reticulatum*	*Combretum micranthum*
	herb. fallow	*Eragrostis tremula*	*Panicum glaucum*	*Sesbania pachiderma*
13	tree	*Boscia senegalensis*	*Combretum micranthum*	*Guiera senegalensis*
	herb. field	*Mitrocarpus scaber*	*Eragrostis tremula*	*Cenchrus biflorus*
	herb. fallow	*Cenchrus biflorus*	*Aristida mutabilis*	*Eragrostis tremula*
14a	tree	*Combretum glutinosum*	*Maerua crassifolia*	*Piliostigna reticulatum*
	herb. field	*Mitrocarpus scaber*	*Eragrostis tremula*	*Cenchrus biflorus*
	herb. fallow	*Cenchrus biflorus*	*Aristida mutabilis*	*Chrosophora senegalensis*
14b	tree	*Faidherbia albida*	*Piliostigna reticulatum*	*Guiera senegalensis*
	herb. field	*Mitrocarpus scaber*	*Eragrostis tremula*	*Cenchrus biflorus*
	herb. fallow	*Aristida mutabilis*	*Alys ovale*	*Aristida sieberiana*
15	tree	*Combretum glutinosum*	*Faidherbia albida*	*Piliostigna reticulatum*
	herb. field	*Eragrostis tremula*	*Mitrocarpus scaber*	*Cenchrus biflorus*
	herb. fallow	*Andropogon gayanus*	*Cenchrus biflorus*	*Eragrostis tremula*
16	tree	*Guiera senegalensis*	*Maerua crassifolia*	*Boscia senegalensis*
	herb. field	*Eragrostis tremula*	*Mitrocarpus scaber*	*Cenchrus biflorus*
	herb. fallow	*Cenchrus biflorus*	*Mitrocarpus scaber*	*Sida cordifolia*
17	tree	*Boscia senegalensis*	*Combretum micranthum*	*Maerua crassifolia*
	herb. fallow	*Sida cordifolia*	*Cenchrus biflorus*	*Mitrocarpus scaber*

Appendix 3: Survey tools for the event chronology analysis (English translation is provided in appendix 8)

DOCUMENT DE TRAVAIL A L'INTENTION DE MESSIEURS OMAROU HAMADOU ET BOUBAKAR YACOUBA

Projet droit de propriété, risque et développement de l'élevage:

Cadre de réflexion pour mener à bien la recherche en milieu villageois (villages de Alkama, Banizoumbou, Toudoun Wada, et Dogon Gao Awakas)

Phase 1 de la recherche:

Objectif principal: Développer une connaissance approfondie du village tant du point de vue de son histoire que de ses habitants.

Objectif complémentaire: Développer une relation de confiance et de respect mutuel avec la population des villages

Développer une connaissance du terroir et de l'utilisation des terres

Préparer les visites éventuelles de Jean-Paul Vanderlinden

Durée de cette phase: 2 semaines par village

Description des activités:

1) Utilisation de la liste du service de l'état civil pour identifier les ménages vivant sur les terres du village

Lors de rencontre avec les villageois il faut tenter de mettre à jour les listes d'état civil.

2) Rencontres avec le chef du village et son entourage.

Les rencontres prendront la forme de ce que l'on appelle un groupe de discussion (Focus

Group en anglais). Vous trouverez en annexe 1 la description de la procédure à suivre pour tout groupe de discussion.

Première rencontre

Établir une liste des personnes présentes lors de la réunion.

Leur expliquer que le but du projet de recherche est de comprendre l'histoire et les personnes de quatre villages du Niger pour pouvoir améliorer les action futures de développement de l'élevage et de l'agriculture au Niger. Leur expliquer qu'il ne s'agit pas d'un projet de développement mais d'un projet qui vise à conseiller les projets et les politiques de développement. Leur expliquer que jamais ils ne sont obliger de répondre aux questions.

Leur demander de réfléchir aux événement les plus important de l'histoire du village (NE PAS LEUR SUGGÉRER DE RÉPONSE ET NE PAS LES PRESSER).

Une fois qu'ils ont répondus seuls et que vous avez noter toutes les réponses aller vérifier **chez vous** si vous avez les données suivantes ceci pour préparer la deuxième rencontre.

Origine de la famille fondatrice:

Date de création du village:

Période en fonction des différentes ethnies présentes:

Date à laquelle le village s'est déplacer la dernière fois pour venir au lieu actuel:

Règnes des différents chefs et dates de pouvoirs:

Les meilleures années:

Les grandes catastrophes: Famines, incendies, mortalité du bétail, épidémies

Histoire des puits et des mare:

Changement au niveau de la politique (Canton, Arrondissement, Département, Pays)

Noter celles que vous avez et celles que vous n'avez pas.

Deuxième rencontre

Établir la liste des personnes présentes à la réunion

Compléter les éléments qui manquent de la première rencontre

Au niveau des ménages (pour 20 ménages de chaque village)

Établir la composition détaillée du ménage (nom du chef, des femmes et des enfants y compris leur age et leur village d'origine.

Phase 2 de la recherche:

Objectif principal: Développer une connaissance approfondie des champs du terroir qui se trouvent à proximité des couloirs de transhumances, à proximité des routes, et à proximité des mares ainsi que des champs qui sont près de la frontière du village.

Objectif complémentaire: Préparer les recherches de terrain approfondie qui seront conduite avec Jean-Paul Vanderlinden.

Durée de cette phase: 2 semaines à 1 mois par village.

Identifier les champs en question et remplir la fiche relative à ce champs.

NOTER TOUJOURS TOUT LES RENSEIGNEMENTS MÊME CEUX QUI NE VOUS SEMBLENT PAS IMPORTANTS CE N'EST QUE APRÈS AVEC MOI QUE NOUS FERONS LE TRIS"

MERCI DU TRAVAIL

ANNEXE 1: La bonne conduite d'un groupe de discussion.

Le groupe de discussion est différant de l'entrevue de groupe car il permet une interaction entre les participants ainsi qu'entre les participants et l'observateurs. La conduite d'un groupe de discussion demande par conséquent beaucoup plus de rigueur de la part de l'observateur. Il s'agit d'un processus participatif qui demeure sous l'entier contrôle de l'observateur.

CE QU'IL FAUT FAIRE

Se présenter chaque fois.

Présenter le projet en traduisant la formule donnée en annexe 2

Expliquer brièvement que le but de la discussion est de récolter tous les avis ainsi que le résultat des conversations des participants.

Remercier les participants.

CE QU'IL NE FAUT PAS FAIRE

Tenir compte de l'avis d'une minorité de participant uniquement.

Laisser un ou deux participant monopoliser la conversation.

Ne pas noter certaines réponses

Perdre le contrôle de la conversation

Être désagréable avec les participants

Souffler des réponses aux participants prématurément.

ANNEXE 2 Fomule à lire chaque fois

Bonjour,

Je m'appelle (donner votre nom). J'effectue des recherches pour l'ILRI qui est basé à

l'ICRISAT. Je participe à un projet de recherche qui est en cours en Afrique et pour lequel je vous demande la permission de pouvoir participer. Comme vous le savez il arrive que des projet échouent par manque de connaissance du terrain. Notre travail consiste a essayer d'apprendre ce qui se passe au niveau des villages afin de pouvoir conseiller plus tard les projets et les politiques. Vous devez comprendre que vous ne bénéficierai pas directement de la recherche mais que si vous en bénéficiez se sera beaucoup plus tard sous la forme de meilleurs projets et politiques. Si vous ne souhaitez pas participer vous avez le droit de refuser. Vous pouvez en outre interrompre le processus quand vous voulez. Les renseignements que nous recueillons seront éventuellement transmis aux services compétents de l'état nigérien ou de tout autre intervenant. Si il existe des renseignement que vous ne souhaiter pas voir partager avec d'autres institutions il faut nous le dire et nous les garderons comme confidentielles. Comprenez vous clairement ce que nous sommes en train de faire? Acceptez-vous de participer?

Fiche de renseignement sur les champs de bordure

Village;_____ Enquêteur_____

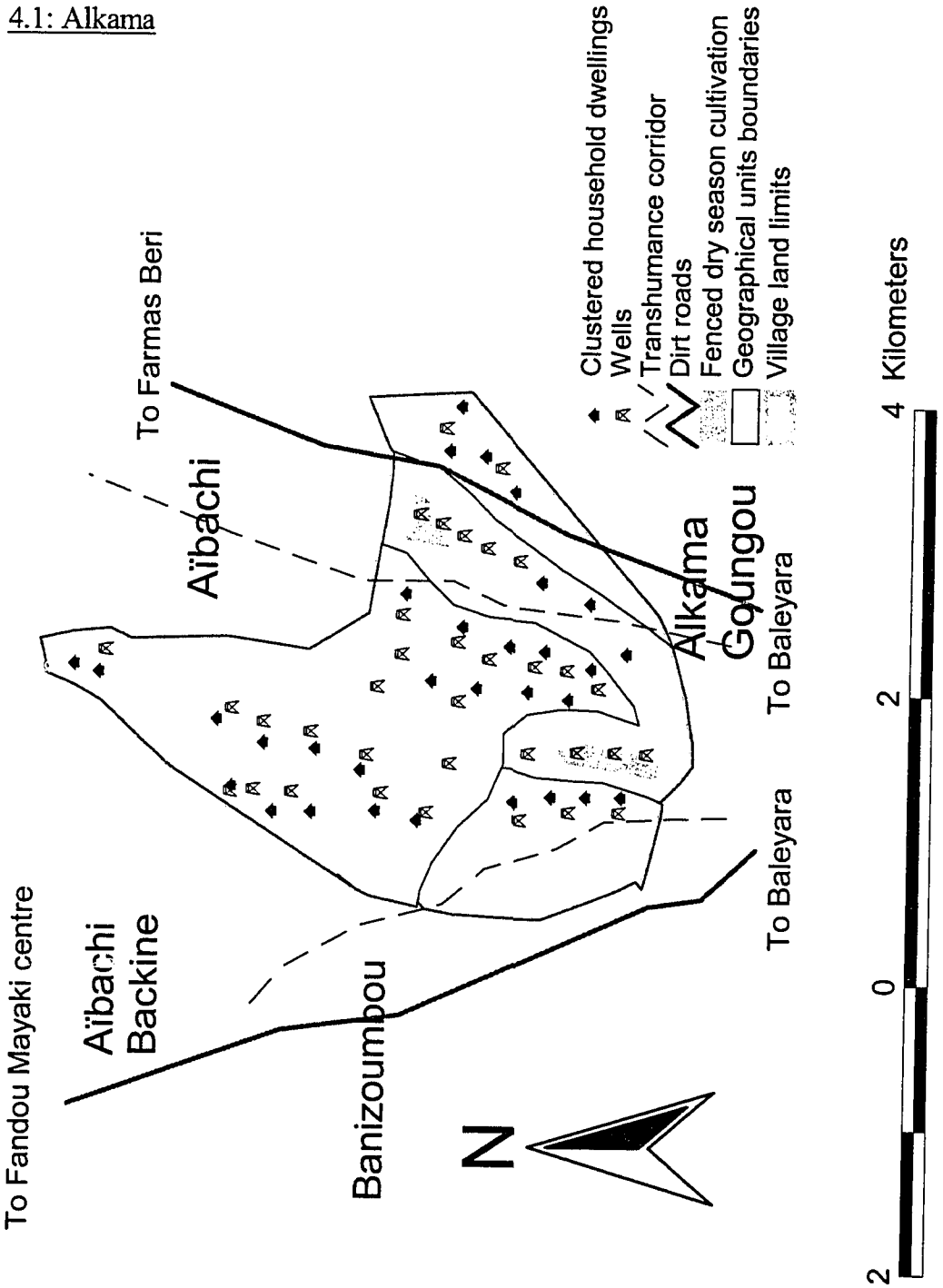
Date de début de l'enquête_____ Date de la fin de l'enquête_____

NOTER **TOUT** AUTRE RENSEIGNEMENT DONNÉ DANS VOTRE CARNET DE TERRAIN ET INDIQUER DANS LA COLONNE ADÉQUATE SI C'EST LE CAS

Nom du champ	Localisation	Propriétaire	Jachère en 98		Cultivé en 97		Mode d'obtention	Dernière année de culture si Jachère en 98 ou dernière année de Jachère si cultivé	Commentaires	
			Oui	Non	Oui	Non			Oui	Non

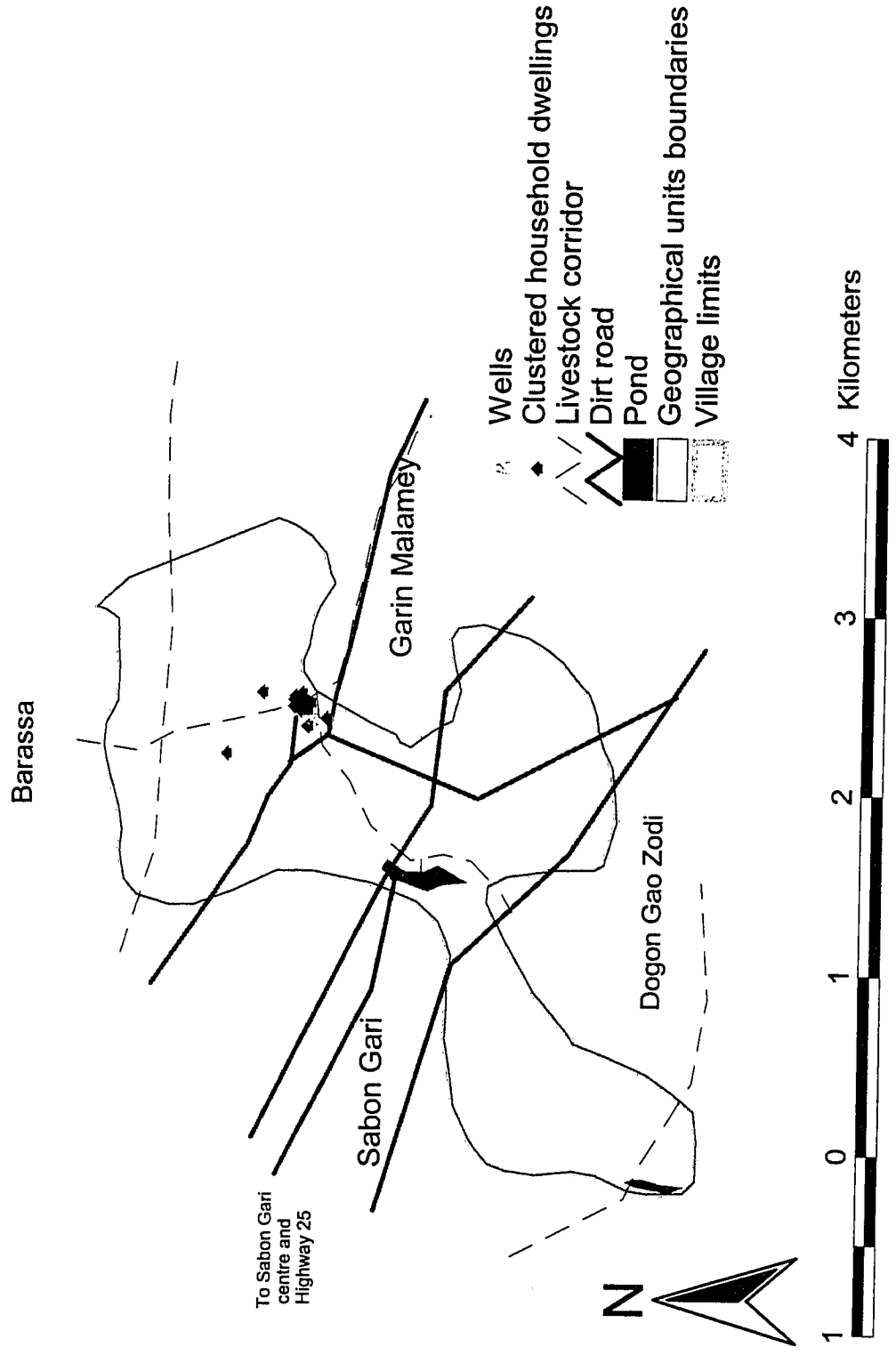
Appendix 4: Detailed map for Alkama, Banizoumbou, Dogon Gao Awakas and Banizoumbou

4.1: Alkama

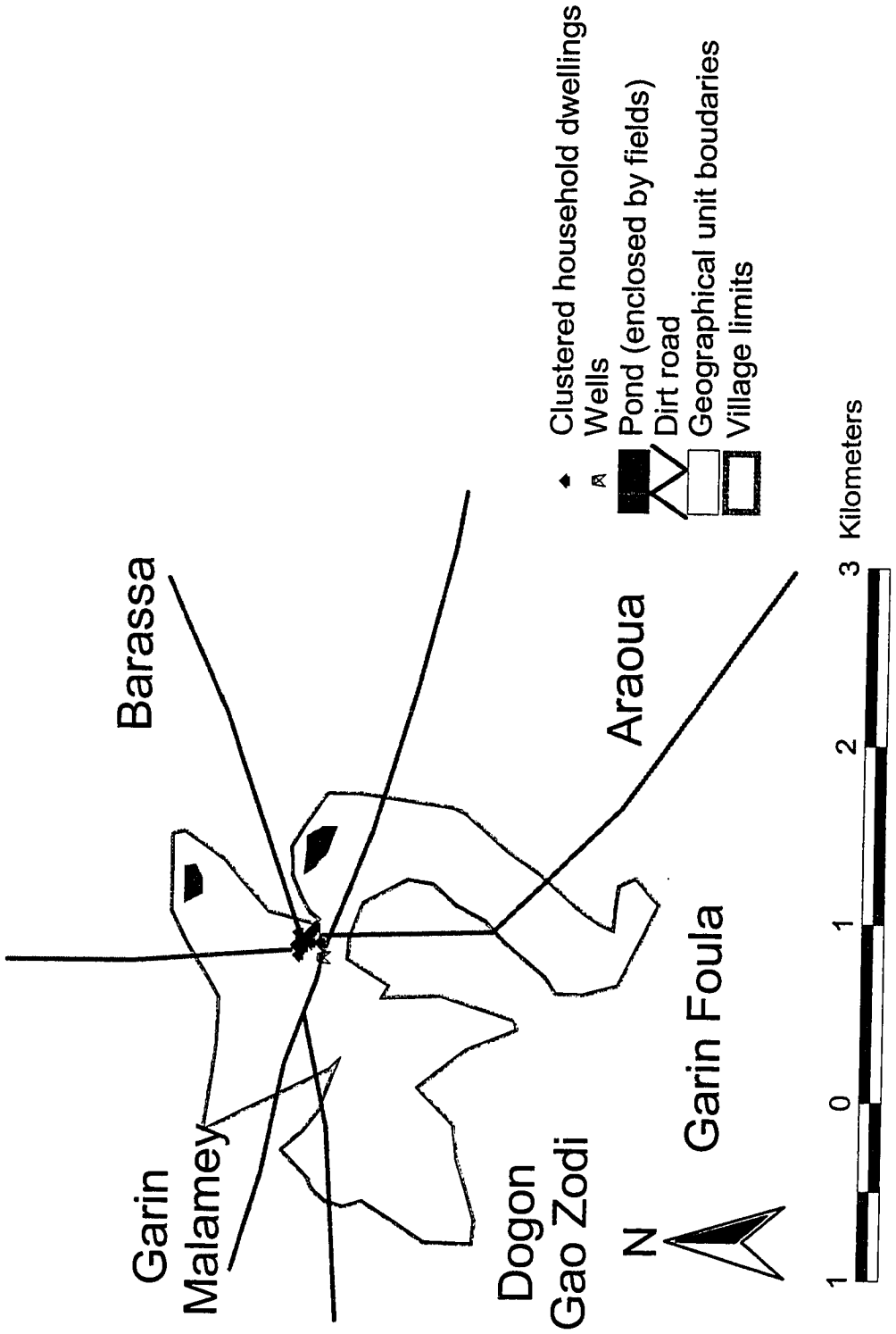


4.2: Banizoumbou

4.3: Dogon Gao Awakas



4.4: Toudoun Wada



Appendix 5: Survey tools for the network analysis (English translation is provided in Appendix 9)

5.1 Interview framework/questionnaire for agropastoralists

Questionnaire à l'intention des chefs de ménage numéro____

Lire la formule habituelle avant chaque entrevue

Village:_____ Date_____ Enquêteur:_____

Nom du chef de ménage:_____ Nom du père_____

Nom de la mère:_____ Localisation de son logement:_____

Depuis quand votre famille est-elle installée dans ce village_____

SECTION I: CHAMPS DU MENAGE

1.)Nombre de champs cultivés en 1998 par le ménage:__

2.)Nombre de champs en jachère en 1998__

3.)Nombre de champs du ménages alloués à un autre ménage en 1998:_____ précisez (à qui, prêt, gage, location etc...)

Nom du champs	Cult	Jach	Aut.	Paiement	Paiement à qui?	Qu'est-ce qui est payé?	Mode d'obtention
1				Oui/non			
2				Oui/non			
3				Oui/non			
4				Oui/non			
5				Oui/non			
6				Oui/non			
7				Oui/non			

5.) Avez-vous fait **un contrat de fumure** pour un ou plusieurs de vos champs dans les deux dernières saisons sèches?

OUI NON Avec qui? (Réponse précise)_____

6.) Comment cela s'est-il passé?_____

SECTION II: BETAIL

1.) Avez-vous du bétail dont le ménage s'occupe OUI-NON Si oui:

2.) Où les **bovins** se nourrissent-ils en **saison des pluies** et qui s'en occupe (réponse détaillée)?_____

3.) Où les **caprins/ovins** se nourrissent-ils en **saison des pluies** et qui s'en occupe (réponse détaillée)?_____

4.) Où les **bovins** se nourrissent-ils en **saison sèche** et qui s'en occupe (réponse détaillée)?_____

5.) Où les **caprins/ovins** se nourrissent-ils en **saison sèche** et qui s'en occupe (réponse détaillée)?_____

6.) Récoltez-vous les résidus de culture pour nourrir le bétail dont vous vous occupez? OUI NON

7.) Si oui dans vos champs uniquement? OUI NON, si NON demandez vous la permission à quelqu'un pour récolter ces résidus? OUI NON Si OUI à qui?____

8.) Récoltez-vous du fourrage dans les jachères ou en brousse pour votre bétail? OUI NON

9.) Si oui, demandez vous la permission à quelqu'un? OUI NON. Si oui, à qui?___

10.) Si votre bétail quittent les terres du villages en transhumance qui décide de la date de départ?_____ qui décide de la date de retour?_____ Qui décide de la destination_____

SECTION III.: COMMUNICATION

Nous allons vous poser une série de questions. Ces questions ont pour but de comprendre comment les gens d'un village se parlent. Comme vous le savez sans doute, certains projets peuvent échouer car ils ne s'adressent pas aux bonnes personnes. Il est important que vous y répondiez en tenant compte de la façon dont la question est posée. S'il s'agit d'une question ne correspondant pas à la réalité je vous demanderai d'imaginer ce que vous feriez si la situation se présentait.

1. Si vous désirez **acheter un bovin** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

2. Si vous désirez **mettre un champs en jachère** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

3. Si vous désirez **acheter du mil** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

4. Si vous désirez **avoir plus de terres** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

5. Si vous désirez **vendre du bétail** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

6. Si vous désirez faire **des cultures de contre saison** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

7. Si vous désirez **engager un berger** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

8. Si vous désirez **engager de la main d'oeuvre salariée pour vous aider au champs** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi?__Dernière fois: Jamais ou__ans Villageois: oui non

9. Si vous désirez **partir en migration saisonnière** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

10. Si vous désirez **envoyer votre bétail en transhumance** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

11. Si vous désirez **louer un champ** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

12. Si votre **bétail est malade** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

13. Si vous **désirez mettre du fumier dans votre champs** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

14. Si vous désirez **parler avec le chef du village** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

15. Si vous désirez **acheter du lait** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

16. Si vous **manquez de mil** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

17. Si vous **désirez acheter un champs** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

18. Si vous constatez des **dégâts par du bétail dans vos champs**, quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

19. Si vous constatez que **l'eau devient rare pour les humains** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

20. Si vous désirez **rencontrer les autorités administrative (sous préfet, chef de poste, juge)** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

21. Si **l'année s'annonce vraiment bonne** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

22. Si la **maladie frappe vos cultures** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

23. Si la **maladie frappe votre famille** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

24. Si une **naissance s'annonce dans votre foyer**, quelles sont les trois premières personnes hors du ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

25. Si un **mariage doit être organisé dans votre foyer** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

26. Si un **malheur frappe votre famille (décès)** quelles sont les trois premières personnes hors de votre ménage à qui vous en parlez? pourquoi? Dernière fois: Jamais ou__ans Villageois: oui non

32.) Pouvez vous citer les 10 personnes avec lesquelles hors de votre foyer vous vous voyez et parlez le plus souvent?

1.)_____ 2.)_____ 3.)_____

4.)_____ 5.)_____ 6.)_____

7.)_____ 8.)_____ 9.)_____

10.)_____

33.) Pouvez vous citer les cinq membres de votre famille que vous voyez le plus souvent hors de votre ménage et préciser le lien de parenté?

1.)_____ Lien de parenté (réponse détaillée s'il vous plait)._____

2.)_____ Lien de parenté (réponse détaillée s'il vous plait)._____

3.)_____ Lien de parenté (réponse détaillée s'il vous plait). _____

4.)_____ Lien de parenté (réponse détaillée s'il vous plait)._____

5.)_____ Lien de parenté (réponse détaillée s'il vous plait)._____ Commentaires:

5.2 Interview framework for herders

Questionnaire à l'intention des bergers.

1. Nom_____ 2. Ethnie_____

3. Age_____ 4. Village d'origine (où il vit la plupart du temps)_____

5. Canton du village d'origine_____

6. Arrondissement du village d'origine_____

7. Il y a combien de temps que vous emmener des animaux en transhumance?___ ans

6. Vous emmener les animaux de combien de propriétaires différents?_____

7. Vous emmener les animaux de combien de villages différents_____

8.Citer le nom des village, le canton et l'arrondissement

Nom du village	Canton	Arrondissement

9. Avez vous des animaux personnels que vous emmenez en transhumance ?

OUI NON

10. Si OUI quelle partie du troupeau: Moins de 1/4, entre 1/4 et ½, entre ½ et 3/4, plus de 3/4.

11. Où emmener vous les animaux en transhumance ?
Canton_____

Arrondissement_____ Allez vous là bas chaque année ? OUI NON

12. Combien de temps mettez vous pour atteindre la
destination_____

13. Expliquez de façon détaillées pourquoi vous choisissez cette destination

14. Avez vous de la famille ou des amis dans cet endroit de destination OUI NON

15. si oui quelle famille où quels amis (expliquer aussi pourquoi ils sont là)_____

16. Est-ce que vous demander la permission à quelqu'un pour vous rendre là bas ?
OUI-NON

17. Si OUI à quelles personnes et pourquoi ? _____

18. Comment choisissez vous le chemin pour aller là bas (explication détaillée) ? 19. Demandez vous la permission pour utiliser les pâturages en chemin ? OUI NON

20. Si OUI à qui et pourquoi (expliquez en détail)_____

21. Comment savez-vous que les pâturages où vous allez sont bons (expliquez en détail)?

22. Est-ce qu'il y a des pâturages où vous ne pouvez pas aller avec les animaux ?

OUI NON

23. Si OUI expliquez pourquoi ?_____

24 L'an passé Y a t'il des villages qui vous ont fait payer pour des dégats dans leurs champs ? OUI NON

25. Si OUI expliquez comment cela s'est-il passé ?_____

26. Quelles sont les difficultés lorsque l'on emmène les animaux en transhumance ?_

Appendix 6: Technical notes on the econometric modelling

6.1 Structural equations

The purpose of these notes is to clarify the development of the structural model.

On the average product function – one pasture user

Livestock production entails the transformation of forage into meat. When considering livestock kept on pastures the average meat production per livestock head is a function of: the total number of livestock on the pasture; a series of technical characteristics such as the pasture's productivity, nutriment availability, livestock species and/or breed, water availability, and, in cases where the livestock are under supervision, of the livestock keeper's ability.

The average product function can therefore be written: $O = f(L,\beta)$.

Where O is the average meat output, L is the total number of livestock on the pasture and β a vector encompassing the technical coefficients.

On total output and revenue – one pasture user

The total meat production (To) when there is a single pasture user is given by
$To = Lf(L,\beta)$

On one individual's output – more than one pasture user

When several livestock owners use the same pastures the meat production for one specific owner (O_i) can be computed by multiplying the number of head owned by the individual owner (L_i)times the average product. Which can be written: $O_i = L_i f(L,\beta)$

If P is the output price, the value of the output of a specific owner, R_i, is written:

$$R_i = PO_i = PL_i f(L,\beta)$$

On one individual's profits – more than one pasture user

When considering the average costs per unit of input (livestock head), c, associated with the herder's activities, the herder's profit, Π_i, is given by:

$$\Pi_i = PL_i f(L,\beta) - cL_i$$

On one risk-averse individual's expected utility – more than one pasture user

Using the mean-variance approximation of expected utility as developed by Hirshleifer and Reily (1992, pp 69-73) and by truncating the Taylor series after the second order term, as in McCarthy (1998), an individual herder's expected utility is given by:

$$EU(\Pi) = [PL_i * f(L;\beta) - cL_i - \tfrac{1}{2}\sigma^2\phi_A(PL_i * f(L;\beta))^2]$$

This equation serves as the basis for the econometric developments of Chapter IV. The mean variance approximation of expected utility is developed by making the assumption that an individual's utility can be proxied by the mean of this individual's revenue. Furthermore, the distribution of one individual's potential utility (in uncertain situations) is proxied by the use of the variance of the revenue. This explains how expected utility is transformed into the equation here above which focuses on the herder's revenue and its variance.

The detailed development is (Hirshleifer and Reily 1992, Chapters 1, 2 and 3):

If $(1,...,x,...,X)$ is a set of acts available to an agent, $(1,...,s,...,S)$ is a set of state available to nature, and $c(x,s)$ is a consequence function showing outcomes under all combinations of acts and states, $\pi(s)$ is a probability function expressing the agent's belief as to the

likelihood of nature choosing each and every state, $U(c)$ a utility function allowing the ordering of the agent's preference over possible consequences c.

Then $EU(x) = \sum_{s=1}^{S} \pi_s U(c_{x,s})$

It is important to note here that, while $U(c)$ represents the ordering of outcomes (combination of acts and state), the expected utility is expressed in terms of the agents acts $(1,...,x,...,X)$.

If we take $U(c)$ and expand it in a Taylor series about its expected value $Ec=\mu$

Then $U(c) = U(\mu) + \frac{U'(\mu)}{1!}(c-\mu) + \frac{U''(\mu)}{2!}(c-\mu)^2 + ...$

Noting that $E(c-\mu)=0$ and that $E((c-\mu)^2)$ is the variance of c, then it is possible to write that:

$$EU = U(\mu) + \frac{U''(\mu)}{2!}\sigma^2 + ...$$

Finally, if the utility is proxied by revenues Π (as argued above) and noting that the coefficient of absolute risk aversion, $\phi_A = \frac{-U''(c)}{U'}$

then: $EU = \Pi - \frac{1}{2}\sigma^2 \phi_A \Pi'' + \ldots$

6.2 On the robustness of the estimation

The use of a two stage least square (2SLS) estimator implies a series of assumptions about the way the observations are generated. First, the model must be correctly specified (i.e., no relevant independent variables are omitted, no irrelevant independent variables are included, and the relationship between the variables must be linear). Second, the expected value of the disturbance term must be zero. Third, the disturbance terms must all have the same variance (are not heteroskedastic) and not be correlated with one another (independent). Fourth, the observations on the independent variables can be considered fixed in repeated samples. Fifth, the independent variables must not be linearly related. The purpose of this section is to present how or to what extent these conditions where met. It must be noted however that MonteCarlo experiments with 2SLS estimators have consistently showed that 2SLS are fairly insensitive to the violations of these assumption when compared with other estimators. This has led some authors to recommend that 2SLS be used as often as possible. (Kennedy 1992, pp. 159-160, 166-167)

Model specification

The specification of proposed the model has been based on two basic assumptions. First, that the structural model that is an acceptable model of the decision process that is modelled. Second, that the level and intensity of the fieldwork conducted allow for the identification of irrelevant and/or omitted variables. Field observation led, in the reduced form equations, to the exclusion of some seemingly key elements of the technical

coefficients which are discussed below. Another issue that is linked with specification is the choice of a linear functional form. This choice is justified by the fact that there is no theoretical justification for choosing a non linear functional form. Estimations were conducted by replacing the different variables with their natural logarithms, however this did not prove conclusive.

Water availability:

The model analyses behaviour during the rainy season. Field observation as well as interviews with herders indicate that water availability is not a concern/constraint during the rainy season.

Species and breeds:

Ample field evidence shows that the choice of species is mostly linked with traditional expertise and availability of funds. Informal conversation with herders and livestock owners pointed to the fact that the differential in productivity (all else being equal) is not considered as important between sheep and cattle. In terms of breed, there are no observable differences in cattle or sheep breeds in the study area.

Heteroskedasticity

A visual observation of the distribution of the disturbance term indicated that heteroskedasticity was an issue. This meant that while the estimates might not be biased their variance is not robust. In order to obtain robust variance estimates the method developed by Huber (1967) and White (1980) was used.

Multicollinearity.

The following table presents the coefficients of correlation between variables. Non of these coefficients seem to indicate a strong correlation between pairs of independent

variables. Each of these coefficients only indicates the existence of correlation between the two variables to which it refers and therefore does not give information on the possibility for three or more variables to be collinear. Nevertheless, there does not seem to be a theoretical reason leading to the suspicion that three or more variables are collinear.

Coefficient of correlation between independent variables

Var.	RQI	Di	RISK	Plm	NC1	NC2	PAST	DISTT
RQI	1.0000	0.0277	0.0849	0.0510	0.1053	-0.0992	-0.1252	0.0277
Di	0.0277	1.0000	0.0584	-0.1776	-0.0212	0.1657	-0.1495	-0.1517
RISK	0.0849	0.0584	1.0000	0.0837	0.0409	-0.1192	-0.0384	0.0854
Plm	0.0510	-0.1776	0.0837	1.0000	0.0236	0.0875	0.0529	-0.1314
NC1	0.1053	-0.0212	0.0409	-0.0236	1.0000	0.0284	-0.0314	0.1345
NC2	-0.0992	0.1657	-0.1192	0.0875	0.0284	1.0000	0.0922	-0.0833
PAST	-0.1252	-0.1495	-0.0384	0.0529	-0.0314	0.0922	1.0000	-0.0675
DISTT	0.0277	-0.1517	0.0854	-0.1314	0.1345	-0.0833	-0.0675	1.0000

6.3 Hypotheses that were tested

The following hypotheses were tested using a two sided t-test with a 5 % level of significaiton (see Table IV.7 for the estimation results and computed t values):

Stocking rate equation:

$$SRRS = \alpha_1 + \alpha_2 RQI + \alpha_3 Di + \alpha_4 RISK + \alpha_5 Plm + \alpha_6 NC1 + \alpha_7 NC2 + \varepsilon_1$$

Where α_i (i=1 to 7) are the estimated coefficients and where ϵ_1 is the stochastic disturbance term. Where the variables are *SRRS* (rainy season pressure on the range),

RQI (range quality index), *Di* (distance from market), *RISK* (rainfall coefficient of variation), *Plm* (price of livestock), *NC1* (non-cooperation index 1), *NC2* (non-cooperation index 2).

Hypothesis 1: The stocking rate on pastures is a function of the range quality index.

H_0: $\alpha_2=0$; H_1 $\alpha_2 \neq 0$

Hypothesis 2: The stocking rate on pastures is a function of the distance from local livestock market

H_0: $\alpha_3=0$; H_1 $\alpha_3 \neq 0$

Hypothesis 3: The stocking rate on pastures is a function of the rainfall coefficient of variation.

H_0: $\alpha_4=0$; H_1 $\alpha_4 \neq 0$

Hypothesis 4: The stocking rate on pastures is a function of the price of livestock

H_0: $\alpha_5=0$; H_1 $\alpha_5 \neq 0$

Hypothesis 5: The stocking rate on pastures is a function of the first non-cooperation index

H_0: $\alpha_6=0$; H_1 $\alpha_6 \neq 0$

Hypothesis 6: The stocking rate on pastures is a function of the second non-cooperation index

H_0: $\alpha_7=0$; H_1 $\alpha_7 \neq 0$

Mobility equation:

$$MOB = \beta_1 + \beta_2 RQI + \beta_3 Di + \beta_4 RISK + \beta_5 Plm + \beta_6 SRRS + \beta_7 PST + \beta_8 DISTT + \varepsilon_2$$

Where β_i (i=1 to 8) are the estimated coefficients and where ϵ_2 is the stochastic disturbance term. Where the variables are *MOB* (proportion of livestock leaving for transhumance), *RQI* (range quality index), *Di* (distance from market), *RISK* (rainfall coefficient of variation), *Plm* (price of livestock), *SRRS* (rainy season pressure on the range), *PST* (the proportion of pastoralists living in the community), *DISTT* (distance to transhumance territories).

Hypothesis 1: The proportion of livestock leaving for transhumance is a function of the range quality index.

H_0: $\beta_2=0$; H_1: $\beta_2 \neq 0$

Hypothesis 2: The proportion of livestock leaving for transhumance is a function of the distance from local livestock market.

H_0: $\beta_3=0$; H_1: $\beta_3 \neq 0$

Hypothesis 3: The proportion of livestock leaving for transhumance is a function of the coefficient of variation of rainfal.

H_0: $\beta_4=0$; H_1: $\beta_4 \neq 0$

Hypothesis 4: The proportion of livestock leaving for transhumance is a function of the price of livestock.

H_0: $\beta_5=0$; H_1: $\beta_5 \neq 0$

Hypothesis 5: The proportion of livestock leaving for transhumance is a function of the rainy season stocking rate on local pastures.

H_0: $\beta_6=0$; H_1: $\beta_6\neq0$

Hypothesis 6: The proportion of livestock leaving for transhumance is a function of the proportion of pastoralists living within the agro-pastoral community.

H_0: $\beta_7=0$; H_1: $\beta_7\neq0$

Hypothesis 7: The proportion of livestock leaving for transhumance is a function of distance between the community and rainy season transhumance destinations.

H_0: $\beta_8=0$; H_1: $\beta_8\neq0$

Sources cited in Appendix 6:

Hirshleifer, J., & Riley, J. (1992). *The Analytics of Uncertainty and Information.* Cambridge: Cambridge University Press.

Huber, P. (1967,). *The behavior of maximum likelihood estimates under non-standard conditions.* Paper presented at the Fifth Berkeley Symposium in Mathematical Statistics and Probability, Berkeley, CA.

Kennedy, P. (1992). *A Guide to Econometrics*. (3rd ed.). Cambridge: MIT Press.

White, H. (1980). A heteroskedasticity-consistant covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica, 48*, 817-830.

Appendix 7: Translation of the survey tools for the community survey

7.1 Interview framework/data collection sheet, community-level socio-economic data. (translated)

Community level survey, village head-person questionnaire

Département _____ Ss préfecture: _____
Canton: _____ Village: _____
Longitude: _____ Latitude: _____
Interviewer: _____ Date: _____

A.: ***History:***

A.a.: Years since the village has been in its current location:_____

A.b.: Year when the current village chief began his mandate:_____

A.c.: Year when land was last granted to outsiders: _____

B.: ***Demographics***

B.a.: Total number of households:_____

B.b.: Language spoken by the majority:_____

B.c.: Other languages that are spoken: _____

B.d.: Majority ethnic group: _____

B.e.: Other ethnic groups: _____ Number of households:_____
_____ Number of households:_____

B.f. Are there hamlets under this village's jurisdiction? Yes No
If yes how many?_____ Are these hamlets from other ethnic groups?
Yes No

B.g. Are there community members living permanently in their fields? Yes No
If yes are they from another ethnic group? Yes No _____

B.h.: Number of non-village members cultivating fields on the village land.:_
Where are they coming from and what is their ethnic group?
_____

B.i.: Number of household heads involved in dry season migration for:
1. This year _____
2. Last year _____
Last year when did they leave?:_____
Last year what were their destinations?_____

C.: ***Land status***

C.a.: Last year what was the number of millet bundles that a single household could produce

maximum ____ minimum____ average _____

C.b.: Importance of sterile land (glacis, gangani):

It represents :

More than 3/4 of the village land? ❑;

More than 1/2 of the village land? ❑;

Less than 1/2 of the village land? ❑;

Less than 1/4 of the village land? ❑

C.c.: Generally speaking the rangelands are good ❑, /average ❑, /bad ❑._____

FOR LAST YEAR

C.d.: What did they do with cowpea residue? Harvest, Sell, Give to their livestock._____

Do they harvest and stock millet residue for their livestock? Yes No

If they do what is the proportion of millet stover that remains in the fields?:

More than 3/4 ❑

More than 1/2 ❑ Less than 1/2 ❑

Is access to the residue remaining in the fields controlled Yes ❑ No ❑

If yes please explain_____

C.e. Last year When did the livestock begin grazing residues in the fields (only the residues!)_____ When did it stop?_____

Last year when did the livestock begin to eat the harvested residue?_____

When did they stop?_____

C.f. Do they use manure on their fields? Yes No

If yes what proportion of households used manure on their fields FOR LAST YEAR

All ❑ More than 3/4 ❑ More than 1/2 ❑

Less than 1/2 ❑ Less than 1/4 ❑

Are they involved in manure contracts for their own fields? Yes No

If yes what proportion of households were involved in manure contracts? LAST YEAR

All ❑ More than 3/4 ❑ More than 1/2 ❑

Less than 1/2 ❑Less than 1/4 ❑

If yes who where the pastoralists involved (transhumant, neighbours, from the village)

D. Livestock

D.a.: Number of household not having a single head of:
Cattle: _____ Sheep: _____ Goats: _____

D.b.: Number of household possessing : (separate by ward for larger villages)

type of livestock	Household number	Largest household herd	Average household herd	Total number for the village/ward
Ward 1:				
cattle				
goats				
sheep				
Ward 2:				
cattle				
goats				
sheep				
Ward 3:				
cattle				
goats				
sheep				
Ward 4:				
cattle				
goats				
sheep				

D.c.: Is there more than one village herd? Yes ❑ No ❑ If yes how many? _____

D.d.: Last year who took care of the herds? Dry season _____
Rainy season_____

D.e.: Do the village herds go into transhumance? Yes ❑ No ❑
If yes please say whether the herders are family members:

What proportion of the village herds are entrusted to a professional herder?__
Number of village herds that are entrusted to a professional herder: _____
For these herds:

	Month of departure	Month of return	Destination	Number of livestock
Herd 1				
Herd 2				
Herd 3				
Herd 4				
Herd 5				

Number of herds that are entrusted to a family member: _____
For these herds:

	Month of departure	Month of return	Destination	Number of livestock
Herd 1				
Herd 2				
Herd 3				
Herd 4				
Herd 5				

D.f. What proportion of cattle does not go in transhumance ?
All ❑ More than 3/4 ❑ More than 1/2 ❑
Less than 1/2 ❑ Less than 1/4 ❑
What proportion of sheep does not go in transhumance ?
All ❑ More than 3/4 ❑ More than 1/2 ❑
Less than 1/2 ❑ Less than 1/4 ❑
What proportion of goats does not go in transhumance ?

All ❑ More than 3/4 ❑ More than 1/2 ❑
Less than 1/2 ❑ Less than 1/4 ❑

D.g.: Are there livestock from neighbouring communities that are using this village's rangeland? Yes ❑ No ❑

If yes, please estimate how many head for each species and by community?

Village	Cattle	Sheep	Goat	When do they graze and for how long

D.h. Description of transhumant herders who passed through the village land LAST YEAR

Where do they come from?_____

_____

_____

When compared to the village herds, what is the importance of transhumant herds?

_____

_____

_____How long do transhumant herds stay _____

_____

When do they arrive_____ when do they leave_____

E Collective action

E.a. Group project - structure

Are there: Work exchange groups (bogou/gayya) Yes ❑ No ❑
Coops Yes ❑ No ❑
Other Yes ❑ No ❑

If other, please explain_____

For each group please give the proportion of participants 3/4, 1/2, 1/4 of the population. This for:

Women's groups _____ Tontines _____ Community grain stocks _____

_____ _____ _____ _____

E.b.: Religious life

The mosque is: worn out ❑, /Average ❑, /new ❑, /brand new ❑, /no mosque in the village ❑. The mosque is maintained by_____

Is there through the mosque a solidarity scheme geared at helping needy community members? Yes ❑ No ❑

If yes, explain the way it works_____

_____

E.c.: Conflict management

How many conflicts were there during the last five years between

Agriculturalists-agriculturalists_____

Agriculturalists-pastoralists_____

Pastoralists-pastoralists_____

For last year please give a detailed description of each conflict with an emphasis on the actors involved and the possible recurrent nature of the conflict

Conflict 1:summary description _____

Conflict between: Agriculturalists-agriculturalists ❑ Agriculturalists-pastoralists ❑ Pastoralists-pastoralists ❑

The conflict is : New ❑, Ancient ❑ Recurrent ❑

Settled for good ? Yes ❑ No ❑

Please list the agents involved in the conflict and give their role in the conflict and its resolution: (please be precise whether different agents played an official or social role in the conflict)

_____

_____

_____

_____

_____

_____

Conflict 2:Summary description_____

Conflict between: Agriculturalists-agriculturalists ❑Agriculturalists-pastoralists

❑Pastoralists-pastoralists ❑
The conflict is : New ❑, Ancient ❑ Recurrent ❑
Settled for good ? Yes ❑ No ❑
Please list the agents involved in the conflict and give their role in the conflict and its resolution: (please be precise whether different agents played an official or social role in the conflict)

_____
_____
_____
_____
_____
_____
_____

F.: ***Geographical and material integration***

F.a.: Where do the community members buy their primary necessities (salt, soap, oil, petroleum, matches, tea, kola...)?_____ How far?_____

F.b.: Where do the community members buy or sell their grain?_____ How far? _____

F.c.: Where do the community members buy or sell their livestock?_____ How far? _____

F.d.: Where do the community members buy or sell their milk? _____

F.e.: How many community members own traction animals?__

F.f.: How many community members own a cart or carriage?_____

F.g.: How many motorcycles are there in the village?_____

F.h.: How many cars/trucks/light trucks are there in the village?_____

F.i. Is there a school? Yes No If Yes from what age to what age

F.j. Are there shops in the village? Yes No

F.k. Are there telephones, electricity, others?_____

_____

G. Socio-political integration

Please discuss the relationship between the village chief and other authorities (Canton chief, chiefs from other villages, prefect). Please be precise when reporting what is said.

FOR LAST YEAR

How often and for what reason did the village chief meet with the chiefs of neighbouring villages?

_____
_____

FOR LAST YEAR
How often and for what reason did the village chief meet with the canton chief?

FOR LAST YEAR
How often and for what reason did the village chief meet with the *sous préfet*?

7.2 Interview framework/data collection sheet for the participatory mapping (translated)

Questionnaire to be administered during the community mapping exercise

Village: _____

The following elements must be identified during the mapping exercise

Location of the interview, location of hamlets.
Location of water points, traditional wells, modern wells, deep bored wells and ponds must be identified. Months when water is available in each source must be identified.
Location of cultivated fields and fallow
Location of rainy season and dry season pastures
Location of forested areas
Location of livestock corridors, identify the users
Identification of neighbouring villages
Identification of natural village land borders

During the mapping the following questions must be answered

Water

Number of water sources of each type where water is available
Year round: Pond_ Traditional well_ Modern well_ Deep bored well____
Seasonally: Pond_ Traditional well_ Modern well_
What are the rules governing water use?

_____
_____

Are these rules broken? __ How many times last year?_____
Were there people who were penalized? Yes ❑ No ❑
If yes, how often?_____
How do the livestock have access to these water sources? During the rainy season

_____

During the dry season_____
_____

Is access to water conditional? Who decides on the conditions? Please explain with details for each water source_____
_____
_____

Are there priority levels for different types of water use, is there an order? Please explain with details for each water source_____
_____
_____

_____

_____

Pastures

Are there common pastures:

During the rainy season Yes ❑ No ❑

During the dry season Yes ❑ No ❑

Describe the pastures

Rainy season_____

_____

Dry season_____

_____

Access to pastures

Rainy season_____

_____

Dry season_____

_____

What are the rules governing pasture use?_____

_____

Are these rules broken? __ How many times last year?_____

Were there people who were penalized? Yes ❑ No ❑

If yes, how often?_____

For each pasture please give the following details:

Pasture1 Rainy season Dry season

Date when the pasture became a common pasture____

Use before it became a pasture_____

Access conditions for village members_____

Access conditions for outsiders_____

Is there a mechanism through which the number of livestock heads is controlled?

Yes ❑ No ❑

If yes explain the details_____

_____

Is there a mechanism through which the period when the pasture is used is regulated?

Yes ❑No ❑

If yes explain the details_____

_____

Who takes the decisions regarding pasture use_____

Pasture 2 Rainy season Dry season

Date when the pasture became a common pasture____

Use before it became a pasture_____

Access conditions for village members_____

Access conditions for outsiders_____
Is there a mechanism through which the number of livestock heads is controled?
Yes ❑ No ❑
If yes explain the details_____
_____
Is there a mechanism through which the period when the pasture is used is regulated?
Yes ❑No ❑
If yes explain the details_____
_____
Who takes the decisions regarding pasture use_____

Livestock corridors

How many livestock corridors pass through the village land? _____
What is their origin?

	Since	Rationale for its existence	users
Corridor 1		_____	_____
Corridor 2		_____	_____
Corridor 3		_____	_____
Corridor 4		_____ _____	_____ _____

What are the rules governing the use of these corridors?_____
_____
_____
Were these rules broken? How often last year?_____
Were some people fined? Yes ❑ No ❑
If yes how many times?_____
Do the livestock passing through livestock corridors eat in fields?
Often ❑ Rarely ❑ Never ❑
Please describe what happens when livestock wander into fields without permission.
_____
_____

7.3. Interview framework/data collection sheet, livestock management practice (translated)

During the last dry season were there livestock that were stolen from the village on the village land? Yes No

If yes, how many?_____

During the last dry season were there livestock from the village that died on the village land? Yes No

If yes, how many?_____ If yes, how many had to be slaughtered?_____

During the last dry season were there livestock that left into transhumance?

Yes No

If yes:

Were there livestock from this village that were stolen during transhumance? Yes No

If yes, how many?_____

Were there livestock from this village that died during transhumance? Yes No

If yes, how many?_____ If yes, how many had to be slaughtered?_

COMMENTS:

_____

_____

_____

If cattle did not leave for transhumance during the rainy season please ask the reasons:

_____

_____

_____

_____

_____

If cattle left for transhumance please ask the following for each season when livestock left.

Rainy season:

Who were the livestock entrusted to?_____

Under what conditions (compensation structure)

_____

_____

_____

Dry season:

Who were the livestock entrusted to?_____

Under what conditions (compensation structure)

_____

_____

_____

7.4 Scoring card and data collection sheet, cattle price survey (translated)

Date:_____
Market:_____
Number:____

Identification key
You must use this key exch time, step by step, before consulting your photographs.

1. **At least 6 pairs of rib are apparent**
2. **Epiphysis are apparent**
3. **The animal is clearly on the brink of death**
4. **The muscle mass between the Tuber Coxae and the tuber ischii is deeply convex**
5. **The tuber coxae are apparent**
6. **There is a layer of fat on the caudal vertebrae**

Yes ---2	No---5
Yes ---3	No---M-
Yes----L-	No---4
Yes ---L	No---L+
Yes----M	No---6
Yes----F	No---M+

Please circle each answer as well as the score

Buyer type:_____

Sex: M F

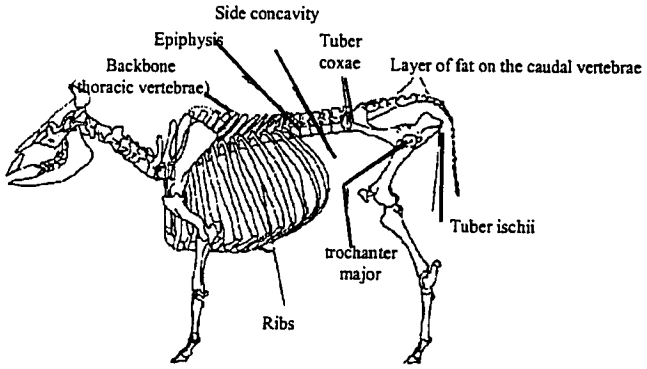
Age:____

Girth:_____

Height:____

Length:_____

Price:_____



Adapted from Nicholson et Butterworth, 1986

7.5. Data aggregation sheet, cattle price survey

Property Rights, Risk and Livestock Development Project
Market price collection sheet for **cattle**. Please fill in every evening using individual scoring cards
Interviewer_____ Date_____ Market___

Number	Sex	Length	Height	Girth	Score	Price	Buyer, trader or individual	comments

Comments:_____

7.6. Data collection sheet, sheep price survey

Property Rights, Risk and Livestock Development Project

Market price collection sheet for **Sheep**

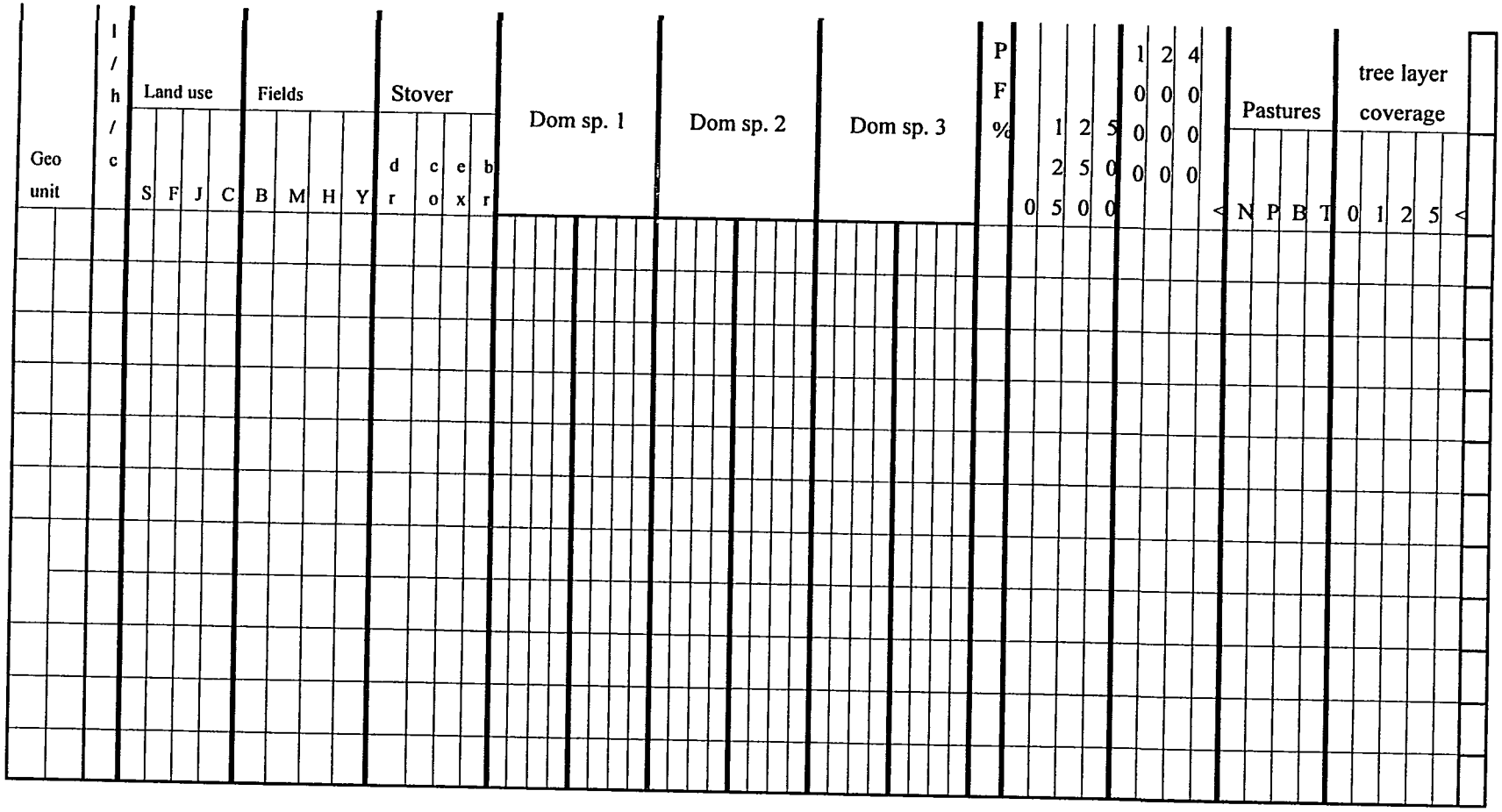
Interviewer_____ Date_____
Market

Number	Sex	Length	Height	Weight	Price	Buyer, trader or individual	Comments/ Age

Comments:_____

7.7. Data collection sheet, vegetation survey (translated)

Terroir_____Date_____Survey done by Jean-Paul Vanderlinden



Appendix 8: Translation of the survey tools for the event chronology analysis

FIELD WORK GUIDELINES FOR OMAROU HAMADOU ET BOUBAKAR YACOUBA

Property rights, risk, and livestock development project:

Advice and instructions for the village level fieldwork (villages of Alkama, Banizoumbou, Toudoun Wada, and Dogon Gao Awakas)

Phase 1 of the fieldwork:

Principal objective: To develop an in depth knowledge of the village both in terms of its population and its history.

Other oibjectives: To develop mutual trust and understanding between yourself and the community members

To develop a knowledge of the village land and the village land use

To prepare for the forthcoming visits of Jean-Paul Vanderlinden.

Duration of phase 1: 2 weeks per village

Activities to be undertaken:

1) Use and update the household list established by the administrative authorities to identify households living on village lands.

When meeting the villagers you must update the population list.

2) Meeting with the village chief and his entourage.

These meetings will be organized as "focus groups". You will find as an appendix to the present document the description of the procedure to be followed for all focus group discussions.

First meeting

List those present.

Explain that the goal of the research is to understand the history and membership of four villages of Niger for the purpose of developing a better understanding of livestock production and agricultural activities in order to better future project interventions. Explain that we are not part of a development project but that we are part of a project that has the goal of bettering development policies and projects. Explain that they are under no obligation whatsoever to participate.

Ask that they think about the most important events in the village's history (DO NOT SUGGEST ANY ANSWER AND DO NOT RUSH THE PROCESS).

Once they have answered and once you have written down everything carefully return to your house. Once at your place check whether you have the following information in order to prepare the next meeting with the same group.

Origin of the founding family:

Date of the village's foundation:

Period where different ethnic groups came to live on the village land:

Date at which the village moved for the last time:

Reign and dates for the different village chiefs

The best years

The major catastrophes: Famines, fire, death of livestock, epidemics

History of wells and ponds

Political changes (Canton, Arrondissement, Département, Pays)

Identify the information that you do not have.

Second meeting

List those present

Complete the elements that are missing from the first meeting

Ask the people present if you can meet with them individually and visit their fields and observe their animals.

Household level survey (for 20 households in each village)

Establish the detailed household composition (name of the head, and of wives and children, taking account of their age and their village of origin).

Phase 2 of the field work:

Principal objective: To develop an in depth knowledge of the fields that are near livestock corridors, near roads, near ponds and near the village limits.

Secondary objective: To prepare for the forthcoming visits of Jean-Paul Vanderlinden in order to be able to identify each of the fields during a visit involving GPS.

Duration of phase 2: 2 weeks to one month per village

Identify the fields and fill in the information relative to these fields.

ALWAYS WRITE DOWN ALL THE INFORMATION REGARDLESS OF WHAT YOU THINK OF ITS RELEVANCE. WE WILL SORT THE COLLECTED INFORMATION TOGETHER ONCE THE FIELDWORK IS COMPLETED

THANK YOU FOR YOUR WORK

APPENDIX 1: Conducting a focus group.

The focus group is different than the group interview because it permits interaction between participants as well as between participants and observers. Therefore, conducting a focus group request a lot of discipline on your side. The focus group is a participatory process in which you keep a thematic control.

DOs

Introduce yourself each time

Introduce the project using appendix 2

Explain briefly the goals of the meeting and collect carefully all the information that results from the conversations of the participants.

Thank the participants.

DON'T:

Take into account only parts of the answers/conversations by prioritizing a more vocal minority.

Let one or two participants be the only ones to speak

Forget to note all answers

Lose control of the conversation

Be disagreeable to the participants

Stifle the responses of the participants too quickly.

APPENDIX 2 Text to be read each time

Good day,

My name is (give your name). I am conducting research for ILRI which is based at ICRISAT (Sadore). I am participating in a research project being conducted now in Africa and for which I am requesting your participation As you may have experienced, development projects may fail due to a lack of knowledge of the village level situation. Our work is an attempt at

understanding life in villages in order to advise project designers and policy makers. It must be clear that you will not benefit directly in any ways from this project, eventually a long time from now, you may benefit through better policy and projects. If you do not wish to participate you are totally allowed to refuse. If at any time during the research you feel uncomfortable you are at all times allowed to refuse answering or to stop participating. The information that we are collecting is shared with state authorities, development projects and research projects. If there are data that you do not wish to share please tell us so and we will keep them confidential. Do you clearly understand what we are doing? Do you wish to participate?

Data collection sheet ("frontier" fields)

Village;_____ Interviewer_____

Date when beginning the collection of information_____

Date of the end of the collection of information_____

NOTE **ALL** OTHER INFORMATION IN YOUR FIELD DIARY. INDICATE IF THESE SUPPLEMENTARY NOTES ARE IN YOUR FIELD DIARY.

Name of the field	Location	Owner	Fallow in 98		Cultivated in 97		Mode of acquisition	Year of the last change in use (fallow to field or field to fallow)	Comments	
			Yes	No	Yes	No			Yes	No

Appendix 9: Translation of the survey tools for the network analysis

9.1 Interview framework/questionnaire for agropastoralists

Questionnaire for the household head number ____

Do not forget to read the usual text before each interview

Village:_____ Date_____ Interviewer:_____

Name of the household head:_____ Name of his father_____

Name of his mother:_____ Location of his house:_____

When did your family begin living in this village_____

SECTION I: HOUSEHOLD'S FIELDS

1.) Number of fields cultivated in 1998 __

2.) Number of fallows in 1998__

3.)Number of fields belonging to the household but cultivated by another household in 1998:_____ explain (whom to, loan, guaranty, lease etc...)

Name of the field	Cult	Fall	Other	Payment	Payment to whom	Rationale for and amount of payment	Acquisition mode
1				Yes/No			
2				Yes/No			
3				Yes/No			
4				Yes/No			
5				Yes/No			
6				Yes/No			
7				Yes/No			

5.) Were you engaged in a manure contract for one or several of these fields during the two last dry seasons?

YES NO With whom? (Be precise)_____

6.) Explain the process which these contracts went through?_____

SECTION II: LIVESTOCK

1.) Do you own livestock YES-NO If YES:

2.) Where are the cattle fed during the rainy season and who tends them (please provide as many details as possible)?_____

3.) Where are the sheep and goats fed during the rainy season and who tends them (please provide as many details as possible)?_____

4.) Where are the cattle fed during the dry season and who tends them (please provide as many details as possible)?_____

5.) Where are the sheep and goats fed during the dry season and who tends them (please provide as many details as possible)?_____

6.) Do you harvest millet residue to feed the livestock? YES NO

7.) If yes, only in your fields? YES NO, if No do you ask permission from someone? YES NO, If yes from whom?____

8.) Do you harvest forage from the fields left in fallow? YES NO

9.) If yes do you ask permission? YES NO. If yes from whom?___

10.) If your livestock leave for transhumance, who decides the date at which they leave the village land?_____ who decides the return date?_____ Who chooses the transhumance destination_____

SECTION III.: COMMUNICATION

1. If you wish to buy cattle, who are the first three persons outside of your household that you are

going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

2. If you wish to leave a field fallow, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

3. If you wish to buy millet, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

4. If you wish to have more land, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

5. If you wish to sell livestock, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

6. If you wish to do dry season cultivation, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

7. If you wish to hire a herder, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

8. If you wish to hire agricultural workers, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

9. If you wish to leave for seasonal migration, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

10. If you wish to send your livestock in transhumance, who are the first three persons outside of

your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

11. If you wish to lease agricultural land, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

12. If your animal is sick, who are the first three persons you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

13. If you wish to manure your fields, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

14. If you wish to speak with the village chief, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

15. If you wish to buy milk, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

16. If you face a shortage of millet, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

17. If you wish to buy a field, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

18. If you note that livestock have eaten into your field, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

19. If you note that water becomes scarce, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured:

Never, _____years. Is it a village member yes no

20. If you wish to meet with administrative authorities (Sous préfet, chef de poste, judge), who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

21. If you note that the year will be particularily good, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

22. If you note that your crops are diseased, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

23. If a familly member is ill, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

24. If a your familly expects a birth, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

25. If a marriage is to be organised in your family, who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

26. If someone passes away in your family , who are the first three persons outside of your household that you are going to talk to about that matter? Why? Last time this occured: Never, _____years. Is it a village member yes no

27.) Can you give the names of the ten persons outside of your household with whom you speak most often?

1.)_____ 2.)_____ 3.)_____

4.)_____ 5.)_____ 6.)_____

7.)_____ 8.)_____ 9.)_____

10.)_____

28.) Can you give the names of the five family members outside of your household that you meet the most often. Can you give the precise kinship tie that links you with this person?

1.)_____ Link of kinship (detailed)._____

2.)_____ Link of kinship (detailed)._____

3.)_____ Link of kinship (detailed). _____

4.)_____ Link of kinship (detailed)._____

5.)_____ Link of kinship (detailed)._____

Comments:

9.2 Interview framework for herders

Questionnaire for herders.

1. Name_____ 2. Ethnic group_____

3. Age_____ 4. Village of origin (the place where he lives most of the time)_____

5. Canton of the village of origin_____

6. Arrondissement of the village of origin_____

7. For how long have you been taking animals in transhumance?_____ years

6. You are taking care of livestock belonging to how many different owners?_____

7. You are taking care of livestock coming from how many different villages_____

8. Please give the villages' names, canton and arrondissement

Village name	Canton	Arrondissement

9. Do you have your own animals that you are taking in transhumance ? YES NO

10. If yes what propotion of the total herd: Less than 1/4, between 1/4 and ½, between ½ and 3/4, more than 3/4.

11. Where do you take the livestock ? Canton_____

Arrondissement_____ Do you go there every year? YES NO

12. How long does it take to reach your destination_____

13. Give a detailed explanation of the reasons for this choice of destination

14. Do you have friends or family there YES NO

15. If yes explain the relationship _____

16. Do you ask permission to go to your destination? YES NO

17.If yes from whom and why ? _____

18. How do you choose the route (detailed explanation) ?

19. Do you ask permission to use the pastures that are on the way? YES NO

20. If yes from whom and why ? _____

21. How do you know that the pastures where you are going are good (detailed explanation)?

22. Are there pastures where you cannot go? YES NO

23. If yes explain why?_____

24 Last year are there villages that fined you because of livestock wandering into fields? YES NO

25. If yes how did it happen?_____

26. What are the difficulties when livestock are taken in transhumance?_____